EXHIBIT 2

SCE&G®
A SCANA COMPANY

Generator Interconnection System Impact Study for SCE&G V.C. Summer Nuclear #2

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SCE&G Nuclear Group

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Generator Interconnection System Impact Study
for
SCE&G V.C. Summer Nuclear #2

A Generator Interconnection System Impact Study is an extension of the previous Generation Interconnection Feasibility Study, and is a detailed study of the SCE&G transmission system considering the full output of the proposed new generation. The System Impact Study includes a full test of the NERC Reliability Standards Table 1 and the SCE&G Internal Transmission Planning Criteria.

General Discussion

The SCE&G Nuclear Group has applied for interconnection of a new 1375 MVA nuclear generator near the existing V.C. Summer site. This new generator would be jointly owed by SCE&G and Santee Cooper, SCE&G would own 55% and Santee Cooper would own the remaining 45%. In this study Santee Cooper's portion of the generator output was represented as delivered to the Santee Cooper system.

In addition to this Interconnection System Impact Study, SCE&G Transmission Planning participated in a joint study with Southern Company, Santee Cooper, Duke Energy and other interconnected transmission providers to evaluate the effect of this generator and other planned generators in the region. Results of this joint study indicated no unacceptable interaction between these planned generators or the identified associated transmission expansion.

In the future, SCE&G Transmission Planning will periodically review the results of this Interconnection System Impact Study to determine if the recommended expansion remains valid.

The previously completed Feasibility Study recommended the following transmission line improvements:

1. Construct a VC Summer #2-Killian 230kV line with B1272 conductor
    - (add 230kV terminal at Killian)
2. Construct a VC Summer #2-Lake Murray 230kV line with B1272 conductor
    - (add 230kV terminal at Lake Murray)
3. Construct a VC Summer #2-VC Summer (existing) Bus #2 230kV line with B1272 conductor
    - (add 230kV terminal at VC Summer #1 Bus #2)
4. Construct a VC Summer #2-VC Summer (existing) Bus #3 230kV line with B1272 conductor
    - (add 230kV terminal at VC Summer #1 Bus #3)
5. Upgrade the existing Denny Terrace-Lyles 230kV line to B1272
6. Upgrade the existing Parr-VC Summer #1 230kV line to B1272
7. Upgrade the existing Parr-VC Summer #2 230kV line to B1272
8. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray
9. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace

10. Upgrade the existing Saluda-McMeekin 115kV line to B1272
11. Upgrade the existing Lake Murray-McMeekin 115kV line to B1272
12. Upgrade the existing Lake Murray-Saluda 115kV to with B1272

In addition, it will be necessary to construct a new 230kV generator substation at the proposed site using a breaker-and-a-half design with seven 230kV terminals.

1. One - for the generator step up transformer
2. One - for station service
3. One - for the new 230kV line to the existing V. C. Summer 230kV bus #2
4. One - for the new 230kV line to the existing V. C. Summer 230kV bus #3
5. One - for the new 230kV line to Lake Murray
6. One - for the new 230kV line to Killian
7. One - for the new 230kV line to Santee Cooper

A total of eleven 230kV breakers are needed at the new generator substation for this design.

To resolve overstressed conditions of several 230kV and 115kV breakers as described in the Short Circuit Analysis section, Transmission Planning recommends replacing the following breakers with higher interrupting capability breakers:

Location	Voltage	Breaker #
VC Summer	230	8722
VC Summer	230	8732
VC Summer	230	8742
VC Summer	230	8772
VC Summer	230	8792
VC Summer	230	8832
VC Summer	230	8842
VC Summer	230	8852
VC Summer	230	8892
VC Summer	230	8912
VC Summer	230	8942
Parr	230	6402
Parr	230	6412
Parr	230	6422
Parr	230	6432
Parr	230	6442
Saluda Hydro	115	562
McMeekin	115	1051
McMeekin	115	2051
Edenwood	115	2712
Edenwood	115	3672
Edenwood	115	3682
Denny Terrace	115	8032
Denny Terrace	115	8042
Denny Terrace	115	8092

The report will be presented as follows:

I. Generation Information
II. Transmission Studies
  A. Power Flow Analysis
  B. Short Circuit Analysis
  C. Stability Analysis
III. Required Interconnection Facilities
IV. Engineering Design & Cost

I. Generator Information

The generator design consists of a single nuclear unit and one step-up transformer. The generator unit will have a maximum gross MVA output capacity of 1,375 MVA and a maximum continuous net MW of 1,165 MW.

The generator design consists of the following information:

MVA – gross:	1375
MW – net:	1165
Power Factor:	between .90 and 1.05
Voltage:	22kV
Speed:	1800 rpm
X'd-sat.: 0.465 PU;	X"d-sat.: 0.325 PU
X2-sat.: 0.320 PU;	X0: 0.237 PU

II. Transmission Studies

A. Power Flow Analysis

Since the completion of the Generation Interconnection Feasibility Study, modifications were made to the 230kV generator substation layout and the arrangement of lines connecting to the existing V.C. Summer substation and the proposed V.C. Summer substation. These changes resulted in the proposed retirement of the Parr 230kV substation. The original improvements along with these proposed modifications were modeled and Transmission Planning has run more detailed power flow analysis of the SCE&G transmission system to include a full test of the NERC Reliability Standards Table 1 and the SCE&G Internal Transmission Planning Criteria. This analysis shows the following overload condition due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Loading (%)	Contingency
Lake Murray-Lyles 115kV line	123	101	Outage of Denny Terrace 230kV Bus #1 and #2 (Category C-9)

Transmission Planning recommends that this contingency event be mitigated by installing a 2nd bus tie breaker at the Denny Terrace 230kV bus.

B. Short Circuit Analysis

The previously complete feasibility study indicated sixteen 230kV breakers and nine 115kV breakers were overstressed due to the additional generation at V. C. Summer and must be replaced. However, five of these 230kV breakers are at Parr 230kV substation and because of the proposed retirement of the Parr 230kV substation, these five breaker replacements are no longer required. Additionally, two 230kV breakers are eliminated at the VC Summer #1 Substation with the new line arrangement. Transmission Planning now recommends that nine 230kV breakers and nine 115kV breakers be replaced as listed in the recommendations section of this report.

C. Stability Analysis

1. Overview of Stability Analysis.
The stability study of the connection of the V.C. Summer #2 AP1000 generator to the SCE&G and SCPSA transmission systems assessed the ability of this generator to remain in synchronism following selected transmission system contingencies. Also reviewed were the adequacy of damping of generation/transmission oscillations and the impact of the proposed generator on the stability performance of other system generators. System voltage responses were examined for indications of voltage instability. In addition, generator frequency responses and the effects of protective system performance were evaluated.

For the system peak load cases, the nearby V.C. Summer #1 generator was simulated as switched off except for where noted as otherwise. In addition, the 230kV transmission line connecting the V.C. Summer #2 generator switchyard to SCPSA's Pomaria substation was switched out. These outages were simulated in order to account for the possibility that major generation and transmission could be out of service during the operation of the connecting facility. Power flow studies showed that these were the generation and transmission outages that resulted in the greatest impact on the reactive output of the V.C. Summer #2 generator.

Rotor angle responses of the V.C. Summer #2 generator were simulated in order to determine if angular instability could result from likely contingencies. Generator frequency deviations were examined in order to determine if generator frequency protection could result in generator tripping. The results of the loss of the V.C.

Summer #2 generator were examined in order to determine if any resulting underfrequency relay operations would lead to system load shedding. Finally, the effects of each contingency on the V.C. Summer #2 230kV switchyard bus were examined along with voltages at the existing V.C. Summer #1 230kV and 115kV Offsite Power Supply buses to determine if the voltage requirements of the Offsite Power Supply buses were violated. Generator response plots are not included but are available for review upon request.

An initial 30 second steady state simulation for the selected connection configuration was performed in order to establish that steady state conditions existed prior to fault conditions. The simulation of each contingency repeated the steady state condition for 1 second prior to introducing permanent fault conditions so that the responses could be compared to the initial steady state condition. In order to determine the effects on all system generators, contingencies were simulated under system peak load conditions and system valley load conditions.

Contingencies were selected in order to satisfy each of four categories as specified by NERC Reliability Standards TPL-001 through TPL-004. As a companion to this study, SCPSA has performed a study of this generator interconnection and has determined that the NERC Reliability Standards are satisfied for its system. An Executive Summary of the SCPSA study of generator rotor angle responses to contingencies on its system follows the results of the SCE&G stability analysis. Although not included in this report, a stability study of this interconnection was also performed for the VCS #2 & VCS #3 Combined Operating License Application (COLA). The results of that study support the findings of this Interconnection Study.

The results of the stability analysis are described in the following sections and are summarized following the detailed results.

2. Results of Peak Load Stability Analysis.

A.1. Steady state conditions (NERC Category A condition)

The interconnection of the V.C. Summer #2 generator was shown to result in system steady state conditions. Generator rotor angles and frequencies showed no deviations through out the 30 second simulation. The voltage at the V.C. Summer #2 bus remained at 232.3kV during the simulation. The voltages at the V.C. Summer #1 Offsite Power Supply buses were constant at 232.3kV and 117.75kV.

A.2. Normal clearing of a three phase fault on the V.C. Summer #2 generator terminal 26kV bus (NERC Category B-1 Contingency)

Following a 1 second steady state period, a permanent fault was simulated at the 26Kv side of the V.C. Summer #2 generator step up transformer. This results in the opening of the generator breaker 5 cycles after the appearance of the fault. Since the station service buses are normally served from the 26kV bus, this operation would result in the loss of the station service loads. However, the station fast transfer scheme switches these loads to the switchyard 230kV bus and allows the continued service of these loads.

Rotor angle oscillations were moderate and well damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and well damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

During the application of the fault, the voltage at the V.C. Summer #2 bus dropped to 121.41kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 125.06kV and 78.98kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 1 cycle of the clearing of the fault.

Steady state conditions were reestablished with no further system operations.

A.3. Delayed clearing of a single line to ground fault on the future V.C. Summer #2 switchyard to the existing V.C. Summer #1 generator switchyard bus #2 (NERC Category C-8 contingency)

Since this contingency places a fault near the existing V.C. Summer #1 generator, this unit was modeled as switched on. All local transmission lines were also modeled as in service. Following a 1 second steady state period, a permanent single phase-to-ground fault was simulated at the V.C. Summer #2 end of the V.C. Summer #2 – V.C. Summer #1 230kV transmission line #2. The circuit breaker at the V.C. Summer #1 end of the line was simulated as operating normally. The breaker and a half scheme at the V.C. Summer #2 switchyard cleared the fault following a fault duration of approximately 0.25 seconds.

During the application of the fault, the voltage at the V.C. Summer #2 bus dropped to 121.44kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 126.94kV and 71.20kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 1 cycle of the clearing of the fault.

Rotor angle oscillations were moderate and were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

A.4. Normal clearing of a three phase fault on the existing V.C. Summer #1 generator switchyard bus #1 (NERC Category D-10 contingency)

Since this contingency places a fault near the existing V.C. Summer #1 generator, this unit was modeled as switched on. All local transmission lines were also modeled as in service. Following a 1 second steady state period, a permanent single three phase fault was simulated at the V.C. Summer #1 bus #1. Since this is the bus that the V.C. Summer #1 generator is connected to that generator was tripped when the fault was cleared. In addition, in order to prevent the Fairfield Pumped Storage generators from becoming unstable, a Special Protection System will need to be installed at the V.C. Summer #1 switchyard that will trip those units as well. The operations to clear the fault and trip the generators will occur within 6 cycles from the appearance of the bus fault.

During the application of the fault, the voltage at the V.C. Summer #2 230kV bus dropped to 6.99kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 0.00kV and 21.79kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 14-15 cycles following the appearance of the fault.

Rotor angle oscillations were moderate and were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

3. Results of Low Load Stability Analysis.
 A.1. Steady state conditions (NERC Category A condition)

The interconnection of the V.C. Summer #2 generator was shown to result in system steady state conditions. Generator rotor angles and frequencies showed no deviations through out the 30 second simulation. The voltage at the V.C. Summer #2 bus remained at 232.3kV during the simulation. The voltages at the V.C. Summer #1 Offsite Power Supply buses were constant at 232.3kV and 116.84kV.

A.2. Normal clearing of a three phase fault on the V.C. Summer #2 generator terminal 26kV bus (NERC Category B-1 Contingency)

Following a 1 second steady state period, a permanent fault was simulated at the 26Kv side of the V.C. Summer #2 generator step up transformer. This results in the opening of the generator breaker 5 cycles after the appearance of the fault. Since the station service buses are normally served from the 26kV bus, this operation would result in the loss of the station service loads. However, the station fast transfer scheme switches these loads to the switchyard 230kV bus and allows the continued service of these loads.

Rotor angle oscillations were small but poorly damped due to the smaller level of synchronizing torque within the system due to the reduced amount of generation on line during system low load conditions. However, the generator rotor angle oscillations were eventually damped and there was no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also small and poorly damped but with no indication of system underfrequency load shedding or generator under/overfrequency operations.

During the application of the fault, the voltage at the V.C. Summer #2 bus dropped to 133.47kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 136.00kV and 74.82kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 1 cycle of the clearing of the fault.

Steady state conditions were reestablished with no further system operations.

A.3. Delayed clearing of a single line to ground fault on the future V.C. Summer #2 switchyard to the existing V.C. Summer #1 generator switchyard bus #2 (NERC Category C-8 contingency)

Since this contingency places a fault near the existing V.C. Summer #1 generator, this unit was modeled as switched on. All local transmission lines were also modeled as in service. Following a 1 second steady state period, a permanent single phase-to-ground fault was simulated at the V.C. Summer #2 end of the V.C. Summer #2 – V.C. Summer #1 230kV transmission line #2. The circuit breaker at the V.C. Summer #1 end of the line was simulated as operating normally. The breaker and a half scheme at the V.C. Summer #2 switchyard cleared the fault following a fault duration of approximately 0.25 seconds.

During the application of the fault, the voltage at the V.C. Summer #2 bus dropped to 115.83kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 121.03kV and 67.65kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. The voltages recovered enough to reset the timers within 2-3 cycles of the clearing of the fault.

Rotor angle oscillations were small and were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also small and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

A.4. Normal clearing of a three phase fault on the existing V.C. Summer #1 generator switchyard bus #1 (NERC Category D-10 contingency)

Since this contingency places a fault near the existing V.C. Summer #1 generator, this unit was modeled as switched on. All local transmission lines were also modeled as in service. Following a 1 second steady state period, a permanent three phase fault was simulated at the V.C. Summer #1 bus #1. Since this is the bus that the V.C. Summer #1 generator is connected to, that generator was tripped when the fault was cleared. In addition, in order to prevent the Fairfield Pumped Storage generators from becoming unstable, a Special Protection System will need to be installed at the V.C. Summer #1 switchyard that will trip those units as well. The operations to clear the fault and trip the generators will occur within 6 cycles from the appearance of the bus fault.

During the application of the fault, the voltage at the V.C. Summer #2 230kV bus dropped to 5.89kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 0.00kV and 18.19kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 12-17 cycles of the appearance of the fault.

Rotor angle oscillations were moderate and were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations. The plots for this case are shown in

A.5. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #2 to Fairfield Pumped Storage Generators # 5-8 (NERC Category D-11 contingency)

Since this contingency places a fault near the existing V.C. Summer #1 generator, this unit was modeled as switched on. All local transmission lines were also modeled as in service. Following a 1 second steady state period, a permanent three phase fault was simulated on the 230kV transmission line that connects the V.C. Summer #1 bus #2 to the Fairfield Pumped Storage units #5-8. When this line was opened these units which were operating in the pumping mode were taken off line. This represents the largest load that can be removed from the system as a result of a single event.

During the application of the fault, the voltage at the V.C. Summer #2 230kV bus dropped to 6.00kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 0.00kV and 18.40kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. The voltage recovery differed between the 230kV and 115kV Offsite Power Supply buses but was easily sufficient to allow all relay timers to reset to prevent the switching of the Engineered Safeguard Features buses from the Offsite Power Supply buses.

Rotor angle oscillations were moderate and were adequately damped with no indication of angular instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

V.C. Summer #2 STABILITY STUDY RESULTS
Peak System Load Cases

A.1. Steady state conditions

A. Generator rotor angles demonstrate steady state condition.
B. There was no indication of voltage instability.
C. Generator frequencies show no deviation.
D. No negative impact on existing V.C. Summer #1 offsite power.
E. NERC Reliability Standard TPL-001 compliance demonstrated.

A.2. Three phase fault with normal clearing on the V.C. Summer #2 generator terminal 26kV bus

A. Moderate rotor angle oscillation for SCE&G generators with good damping and no indication of instability.
B. There was no indication of voltage instability.
C. Generator frequency responses are moderate and well damped with no system UFLS or generator under/over frequency operations.
D. No negative impact on existing V.C. Summer #1 offsite power.
E. NERC Reliability Standard TPL-002 compliance demonstrated.

A.3. Single line to ground fault with delayed clearing on the future V.C. Summer #2 switchyard to the existing V.C. Summer #1 generator switchyard bus #2

A. Moderate rotor angle oscillation for SCE&G generators with good damping and no system instability.
B. There was no indication of voltage instability.
C. Generator frequency responses are moderate and well damped with no system UFLS or generator under/over frequency operations.
D. No negative impact on existing V.C. Summer #1 offsite power.
E. NERC Reliability Standard TPL-003 compliance demonstrated.

A.4. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #1

A. Moderate rotor angle oscillation for SCE&G generators with adequate damping, but Special Protection Scheme to trip Fairfield Pumped Storage generators is needed.
B. There was no indication of voltage instability.
C. Generator frequency responses are moderate and well damped with no system UFLS or generator under/over frequency operations.
D. Special Protection System to trip Fairfield Pumped Storage #1-8 required.
E. No negative impact on existing V.C. Summer #1 offsite power.
F. NERC Reliability Standard TPL-004 compliance demonstrated.

V.C. Summer #2 STABILITY STUDY RESULTS
System Low Load Cases

A.1. Steady state conditions

A. Generator rotor angles demonstrate steady state condition.
B. There was no indication of voltage instability.
C. Generator frequencies show no deviation.
D. No negative impact on existing V.C. Summer #1 offsite power.
E. NERC Reliability Standard TPL-001 compliance demonstrated.

A.2. Three phase fault with normal clearing on the V.C. Summer #2 generator terminal 26kV bus

A. Small rotor angle oscillation for SCE&G generators with poor but adequate damping.
B. There was no indication of voltage instability.
C. Generator frequency oscillations small with poor but adequate damping.
D. No negative impact on existing V.C. Summer #1 offsite power.
E. NERC Reliability Standard TPL-002 compliance demonstrated.

A.3. Single line to ground fault with delayed clearing on the future V.C. Summer #2 switchyard to the existing V.C. Summer #1 generator switchyard bus #2

A. Small rotor angle oscillation for SCE&G generators with adequate damping.
B. There was no indication of voltage instability.
C. Generator frequency oscillations also small with adequate damping.
D. NERC Reliability Standard TPL-003 compliance demonstrated.

A.4. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #1

A. Moderate rotor angle oscillation for SCE&G generators with adequate damping.
B. There was no indication of voltage instability.
C. Generator frequency oscillations moderate and adequately damped.
D. Special Protection System to trip Fairfield Pumped Storage #1-8 required.
E. No negative impact on existing V.C. Summer #1 offsite power.
F. NERC Reliability Standard TPL-004 compliance demonstrated.

A.5. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #2 to Fairfield Pumped Storage Generators #5-8

A. Moderate rotor angle oscillation for SCE&G generators with adequate damping.
B. There was no indication of voltage instability.
C. Generator frequency oscillations moderate and adequately damped.
D. No negative impact on existing V.C. Summer #1 offsite power.
E. NERC Reliability Standard TPL-004 compliance demonstrated.

3. SCPSA Executive Summary

Santee Cooper has completed a portion of a joint utility assessment evaluating the dynamic performance of the bulk transmission system performance with the addition of a proposed 1,165 MW generating unit at the existing V.C. Summer site. Assessments are based on Reliability Standards adopted by the North American Electric Reliability Corporation (NERC) used simulated contingency events of projected 2015 summer and light-load seasons.

This study assesses both the transient stability and dynamic stability under normal operation and for selected contingencies simulated within the Santee Cooper electric system. The study focuses on selected contingency events addressing each of the four contingency Categories defined by NERC Reliability Standards TPL-001 through TPL-004. Contingencies selected for inclusion in this study focus on assessing the impact of specific, proposed changes in the power system network configuration and operating scenario associated with the proposed 1,165 MW generating unit addition at the existing V.C. Summer site.

Study scenario contingencies are applied to dynamic simulation models representing projected summer peak and light-load system conditions for 2015. These models were developed with coordinated input from Santee Cooper, SCE&G, Southern Company, Duke and Progress Energy Carolinas. Since it is impractical to include all possible contingency scenarios in specific stability assessments, those contingency scenarios judged most likely to impact the stability of Santee Cooper facilities are incorporated in this evaluation of actual or proposed system changes. Contingency events evaluated and assessments of each simulation are detailed in Table 1. Selected plots for each scenario are included for each simulation under projected summer peak and light-load conditions.

Review and appraisal of each of the scenarios evaluated do not identify any performance issues within the Santee Cooper bulk transmission system resulting from the proposed additional generation at the V.C. Summer site. Each of the selected contingency scenarios from Categories A, B and C and D of NERC Planning Standard TPL-001 through 004, Table 1 indicates that the Santee Cooper system is expected to comply with the requirements outlined for these contingency categories in the projected representation of both the 2015 summer and light-load seasons.

Table 1
Contingency Simulations

Scenario #	NERC Category	Description	Findings
1	B-2	Newberry 230 kV to Pomaria 230 kV line has a fault next to Newbery 230 kV Switching 230 kV switching station. The line is opened and closed under normal breaker operation causing the fault to clear.	Both seasonal case scenarios exhibit good damping following the disturbance. Machine relative angles quickly return to pre-disturbance values without significant swings.
2	C-3	Newberry 230 kV to Greenwood County 230 kV line has a fault next to Newbery 230 kV Switching 230 kV switching station. The line is opened under normal breaker operation causing the fault to clear. This line is not closed. 5 seconds later the Newberry 230 kV to Pomaria 230 kV line has a fault next to Newbery 230 kV Switching 230 kV switching station. The line is opened and closed under normal breaker operation causing the fault to clear.	Both seasonal case scenarios exhibit good damping following both the 1st and 2nd disturbance. Machine relative angles quickly return to pre-disturbance values without significant swings during either of the disturbances.
3	C-5	Failure of common structure causes both Greenwood to Hodges 230 kV and Greenwood to Rainey 230 kV lines to have a single line to ground fault. Both lines are taking out of service by normal breaker operation resulting in the clearing of the fault.	Both scenarios exhibit good damping following the disturbance. The summer scenario indicates that machine relative angles quickly returning to pre-disturbance values with no significant swings following the disturbance. The light-load scenario shows machine relative angles quickly finding new steady states of operation with no significant swings.
4	C-7	A single line to ground fault on the Camden to Lugoff 230kv occurs near the Camden switching station. Due to slow breaker operation there is a delay in clearing the fault. The Camden to Lugoff 230 kV line is opening and then closed resulting in clearing the fault.	Both scenarios exhibit good damping following the disturbance. The machine relative angles quickly return to pre-disturbance values no significant swings.
5	D-3	Fault on line near Newberry 230 kV station is not cleared due to breaker failure. The station is then drop by secondary breaker protection.	Machine relative angles exhibit wider swings than those identified for the summer season, though both seasonal scenarios exhibit good damping following the disturbance.
6	D-4	Fault occurs on Pomaria 230 kV buss tie breaker resulting is delayed clearing of 230 kV lines and loss of Pomaria bus.	Results indicate that oscillations following the disturbance are well-damped for both seasonal scenarios.
7	D-5	Fault on Blythewood 230 to 69 kV transformer results in opening and closing of both VC Summer to Blythewood 230 kV and Blythewood to Lugoff 230k kV lines. Both Blythewood 230 to 69 kV transformers are tripped resulting in loss of 230 kV support to the Santee Cooper 69kV system.	Both scenarios exhibit good damping following the disturbance. The machine relative angles quickly return to pre-disturbance values no significant swings.

4. Stability Study Conclusions

This study demonstrates that the proposed V.C. Summer #2 generator interconnection to the SCE&G and SCPSA systems is compliant with NERC Reliability Standards. There was no indication of voltage instability. None of the simulations indicated that system UFLS or generator under/overfrequency operations would occur. Neither does the interconnection have a negative impact on the existing V.C. Summer #1 offsite power quality. Several cases with faults located near the V.C. Summer #1 and the Fairfield Pumped Storage units revealed a need for a Special Protection System that will trip the Fairfield units to prevent instability. The SCE&G Relay and SCADA Applications department has identified the operating features of such a scheme and will need to make the required system protection improvements.

III. Required Interconnection Facilities

The analyses performed in this study confirmed the results of the Feasibility Study and show that constructing two new 230kV lines from the VC Summer site to the Columbia Area load center, plus additional transmission improvements described below, are required to reliably transmit the 1,165 MW of the proposed VC Summer #2 generator from of the VC Summer area to the remainder of the SCE&G system. Also, the analyses show that constructing two new 230kV lines is less costly and more effective than upgrading the numerous existing 230kV transmission facilities that currently transmit power from the VC Summer area.

The required transmission improvements:

1. Construct a VC Summer #1 bus #1 - Killian 230kV line with B1272 conductor. (add 230kV terminal at Killian)
2. Construct a VC Summer #2 - Lake Murray 230kV line with B1272 conductor. (add 230kV terminal at Lake Murray)
3. Construct a VC Summer #2 - VC Summer #1 bus #2 230kV line with B1272 conductor. (add 230kV terminal at VC Summer #1 bus #2)
4. Construct a VC Summer #2 - VC Summer #1 bus #3 230kV line with B1272 conductor. (add 230kV terminal at VC Summer #1 bus #3)
5. Upgrade the existing Denny Terrace-Lyles 230kV line to B1272
6. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray
7. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace
8. Upgrade the existing Saluda-McMeekin 115kV line to B1272
9. Upgrade the existing Lake Murray-McMeekin 115kV line to B1272
10. Upgrade the existing Lake Murray-Saluda 115kV to with B1272
11. Add a second 230kV bus tie breaker at Denny Terrace

Construct a new 230kV generator substation at the proposed site using a breaker-and-a-half design with ten 230kV terminals. To minimize the number of line crossings and to retire the Parr 230kV substation, several existing lines are being re-terminated at the VC Summer #2 substation and some of the new required lines are terminating at the VC Summer #1 substation.

1. VC Summer #2 generator step up transformer
2. VC Summer #2 station service
3. New 230kV line to VC Summer #1 bus #2
4. New 230kV line to VC Summer #1 bus #3
5. New 230kV line to Lake Murray
6. Re-terminate existing 230kV line to Lake Murray
7. Re-terminate existing 230kV line to Bush River (Duke)
8. Re-terminate existing 230kV line to Graniteville
9. Re-terminate existing 230kV line to Denny Terrace
10. Re-terminate existing 230kV line to Newberry (Santee)

A total of eighteen 230kV breakers are needed at the new generator substation for this design.

To resolve overstressed conditions of several 230kV and 115kV breakers as described in the Short Circuit Analysis section, the following breakers must be replaced with higher interrupting capability breakers:

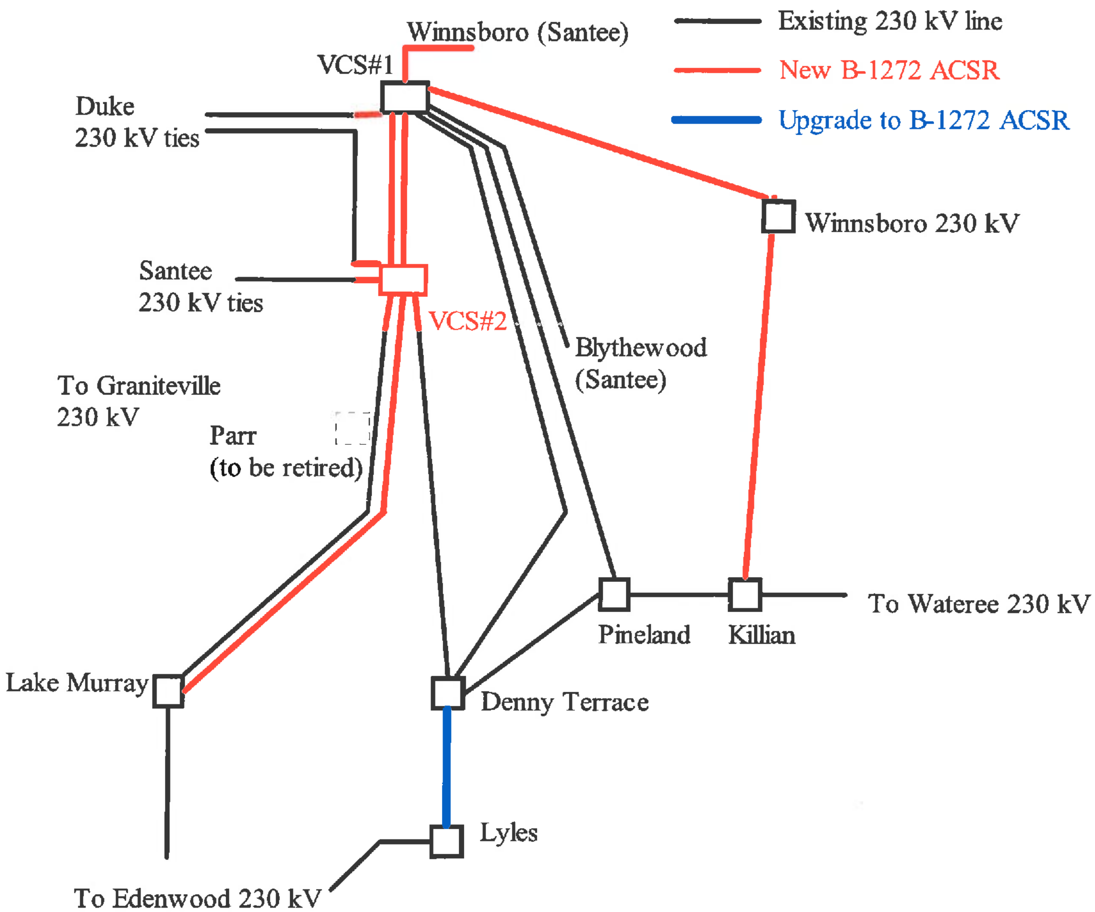
Location	Voltage	Breaker #
VC Summer	230	8722
VC Summer	230	8772
VC Summer	230	8792
VC Summer	230	8832
VC Summer	230	8842
VC Summer	230	8852
VC Summer	230	8892
VC Summer	230	8912
VC Summer	230	8942
Saluda Hydro	115	562
McMeekin	115	1051
McMeekin	115	2051
Edenwood	115	2712
Edenwood	115	3672
Edenwood	115	3682
Denny Terrace	115	8032
Denny Terrace	115	8042
Denny Terrace	115	8092

As stated in the stability analysis section, several cases with faults located near the V.C. Summer #1 and the Fairfield Pumped Storage units revealed a need for a Special Protection System that will trip the Fairfield units to prevent instability. The SCE&G Relay and SCADA Applications department has identified the operating features of such a scheme and will need to make the required system protection improvements.

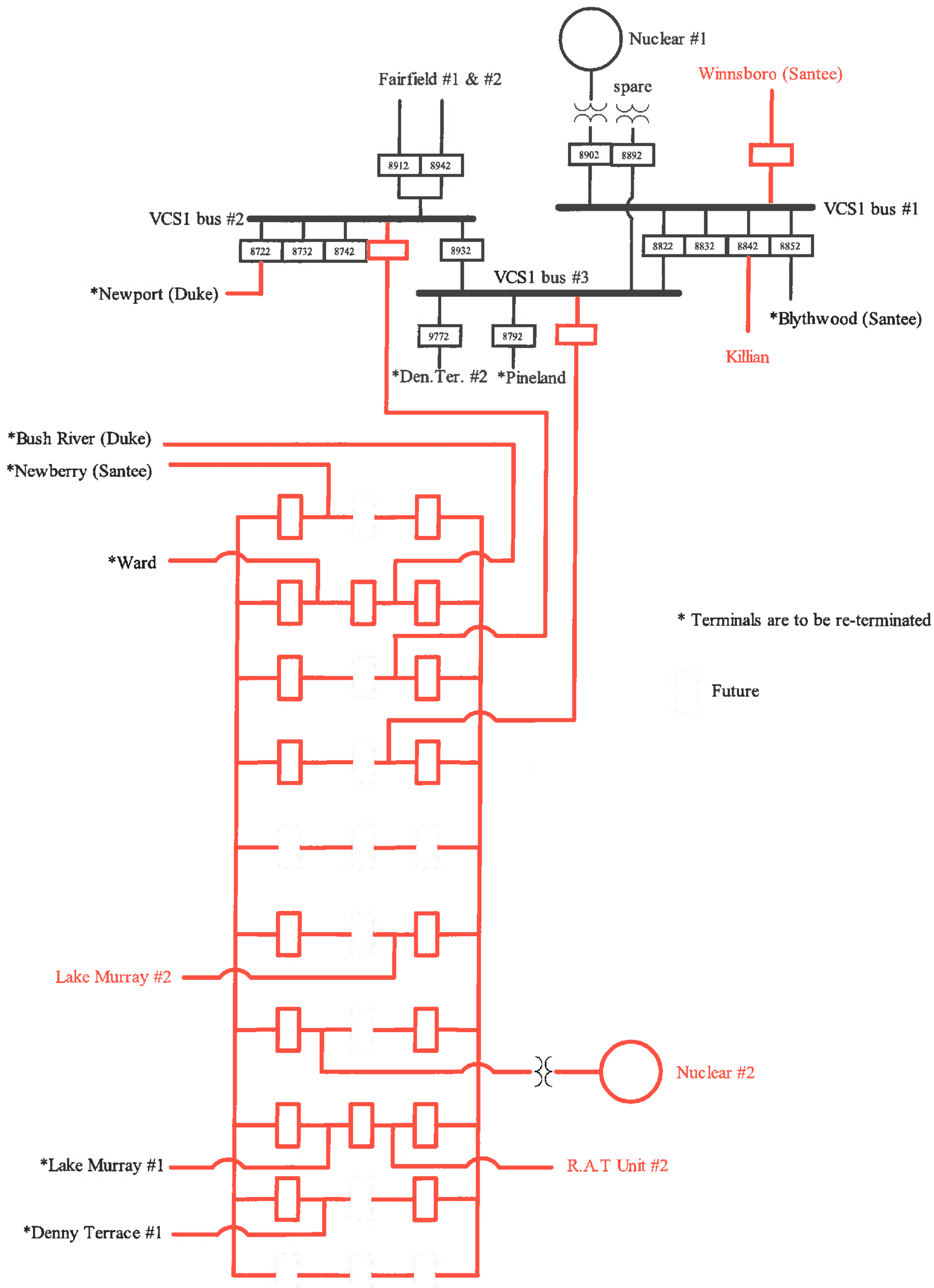
IV. Engineering Design & Cost

A. Engineering Single line Layout & Substation Arrangement

Transmission Single Line



Substation Arrangement



B. Transmission & Substation Cost

All cost estimates are in 2006 dollars.

1. Construct VC Summer-Killian 230kV 25,000,000
    - (add 230kV terminal at Killian)..600,000
2. Construct VC Summer-Lake Murray 230kV......................................17,000,000
    - (add 230kV terminal at Lake Murray) 600,000
3. Construct VC Summer #2-VC Summer #1 bus #2 600,000
    - (add 230kV terminal at VC Summer #1 bus #2)......................600,000
4. Construct VC Summer #2-VC Summer #1 bus #3 600,000
    - (add 230kV terminal at VC Summer #1 bus #3)......................600,000
5. Upgrade existing Denny Terrace-Lyles 230kV 1,500,000
6. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray 5,000,000
7. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace 8,000,000
8. Upgrade existing Saluda-McMeekin 115kV line 125,000
9. Upgrade existing Lake Murray-McMeekin 115kV line.............................500,000
10. Upgrade existing Lake Murray-Saluda 115kV 450,000
11. Add second 230kV bus tie breaker at Denny Terrace 500,000

Construct a new 230kV generator substation at the proposed site using a breaker-and-a-half design with ten 230kV terminals 12,589,000

Construct Transmission from VC Summer #2 Generator to VC Summer #2 Switchyard..340,000

Re-terminate VC Summer area lines to the VC Summer #2 Substation 1,271,000

1. Re-terminate Bush River (Duke) 230kV line to VC Summer #2 substation
2. Re- terminate Newberry (SCPSA) 230kV line to VC Summer #2 substation (paid by SCPSA)
3. Re-terminate Ward 230kV line to VC Summer #2 substation
4. Re-terminate Lake Murray 230kV #1 line to VC Summer #2 substation
5. Re-terminate Denny Terrace 230kV #1 line to VC Summer #2 substation

Re-terminate VC Summer area lines to the VC Summer #1 Substation 681,000

1. Re-terminate Blythewood (SCPSA) 230kV line to VCS bus #1 (paid by SCPSA)
2. Re-terminate Pineland 230kV line to VCS bus #3
3. Re-terminate Denny Terrace 230kV line #2 to VCS bus #3
4. Re-terminate Newport (Duke) 230kV line to VCS bus #2

Replace overstressed
1. 230kV breakers - 9 4,500,000
2. 115kV breakers - 9 2,700,000

Total Cost Estimate..$83,756,000

V. Adjustments to the VC Summer #2 Interconnection Plan

SCE&G Transmission Planning is adjusting the VC Summer #2 generator interconnection plan to consider future native load needs of the system. The existing system has limited capability to serve future load growth along the Interstate 77 corridor. Without reactive compensation, the system can serve only an additional 40 MW of customer load. With reactive compensation, 81 MW can be served.

Transmission Planning is expecting the load along I-77 to grow rapidly in the future, exceed the additional 81 MW amount and, at that time, the area will need additional transmission expansion to reliably serve the growing load.

Transmission Planning is recommending that the VC Summer – Killian 230kV transmission line, discussed above in this report, be routed from VC Summer to Winnsboro and then to Killian. This will extend the 230kV line but with relatively little additional cost this will also provide for service along the I-77 corridor for many years into the future.

A SCANA COMPANY

Generator Interconnection System Impact Study for SCE&G V.C. Summer Nuclear #3

Prepared for:
SCE&G Nuclear Group

August 31, 2007

Prepared by:
SCE&G Transmission Planning

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Generator Interconnection System Impact Study for SCE&G V.C. Summer Nuclear #3

A Generator Interconnection System Impact Study is an extension of the previous Generation Interconnection Feasibility Study, and is a detailed study of the SCE&G transmission system considering the full output of the proposed new generation. The System Impact Study includes a full test of the NERC Reliability Standards Table 1 and the SCE&G Internal Transmission Planning Criteria.

General Discussion

The SCE&G Nuclear Group has applied for interconnection of an additional 1375 MVA nuclear generator near the existing V.C. Summer site. This new generator would be jointly owed by SCE&G and Santee Cooper, SCE&G would own 55% and Santee Cooper would own the remaining 45%. In this study Santee Cooper's portion of the generator output was represented as delivered to the Santee Cooper system.

In the future, SCE&G Transmission Planning will periodically review the results of this Interconnection System Impact Study to determine if the recommended expansion remains valid.

The previously completed Feasibility Study recommended the following transmission line improvements:

1. Construct VCS New-St George 230kV Double Circuit B1272 line (135 miles)
   (Add two 230kV terminals at VC Summer New using breaker-and-a-half design)
2. Construct VCS New-VCS#1, Bus #1 230kV line
   (Add one 230kV terminal at existing VC Summer Bus #1)
   (Add one 230kV terminal at VC Summer New using breaker-and-a-half design)
3. Establish a St George 230kV Switching Station using breaker-and-a-half design
   (6 terminals - 9 breakers)
   (Add land)
4. Fold-in the Canadys-Santee 230kV line at St George 230kV
5. Upgrade the Canadys-St George 230kV line to B1272
   (Upgrade Canadys terminal)
6. Fold-in the Wateree-Summerville 230kV line at St George 230kV
7. Upgrade the St George-Summerville 230kV line to B1272

(Upgrade Summerville terminal)

8. Upgrade Saluda-Georgia Pacific 115kV Double Circuit line to 1272
   (Upgrade Saluda terminal)

Add five (5) terminals (9 breakers) to the VC Summer New substation using breaker-and-a-half design.

1. One - for VC Summer #3 generator step up transformer
2. One - for VC Summer #3 station service
3. One - for the new 230kV line to the existing VC Summer #1 230kV bus #1
4. Two - for the 2 new 230kV lines to St George

To resolve overstressed conditions of the breakers as described in the Short Circuit Analysis section, Transmission Planning recommends replacing the following breakers with higher interrupting capability breakers:

Location	Voltage	Breaker #
VC Summer	230	8822
VC Summer	230	8932
VC Summer	230	8902
Lyles	115	732
Edenwood	115	3052
Dunbar	115	1112
A.M. Williams	115	5712
St. George	115	5002
St. George	115	5022
St. George	115	5052
St. George	115	5082

I. Generator Information

The generator design consists of a single nuclear unit and one step-up transformer. The generator unit will have a maximum gross MVA output capacity of 1,375 MVA and a maximum continuous net MW of 1,165 MW.

The generator design consists of the following information:

MVA – gross:	1375
MW – net:	1165
Power Factor:	between .90 and 1.05
Voltage:	26kV
Speed:	1800 rpm
X'd-sat.: 0.397 PU;	X"d-sat.: 0.261 PU
X2-sat.: 0.261 PU;	X0: 0.176 PU

II. Transmission Studies

A. Power Flow Analysis

Since the completion of the Generation Interconnection Feasibility Study, modifications were made to the 230kV generator substation layout and the arrangement of lines connecting to the existing V.C. Summer substation and the proposed V.C. Summer substation. These changes resulted in the proposed retirement of the Parr 230kV substation. The original improvements along with these proposed modifications were modeled and Transmission Planning has run more detailed power flow analysis of the SCE&G transmission system to include a full test of the NERC Reliability Standards Table 1 and the SCE&G Internal Transmission Planning Criteria.

Three different projected loading conditions were simulated for the 2019 time period: Summer Peak Load, Shoulder Load (75% of peak) and Light Load (38% of peak).

For the Summer Peak Load and Shoulder Load simulations, the analysis identified no additional overload conditions due to the additional generation that had not already been previously identified in the Feasibility Study. However, for the Light Load simulation, the following new conditions occurred:

In the basecase, with no outages, the VC Summer-Newport (Duke) 230kV line loads to 98% of its continuous rating of 437 MVA.

The n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Rating (MVA)	Loading (%)	Contingency(s)
VC Summer #1 bus #2-Newport (Duke) 230kV line	456	104	VC Summer #1 bus #1-Winnsboro (Santee Cooper) 230kV line and VC Summer #1 bus #1-Blythewood (Santee Cooper) 230kV line
VC Summer #1 bus #2-Newport (Duke) 230kV line	456	104	VC Summer New-Pomaria (Santee Cooper) 230kV line #1 and VC Summer New-Pomaria (Santee Cooper) 230kV line #2
VC Summer #1 bus #2-Newport (Duke) 230kV line	456	103	VC Summer New-Bush River (Duke) 230kV line and VC Summer #1 bus #1-Blythewood (Santee Cooper) 230kV line
VC Summer #1 bus #2-Newport (Duke) 230kV line	456	103	VC Summer New-Bush River (Duke) 230kV line and VC Summer #1 bus #1-Winnsboro (Santee Cooper) 230kV line
VC Summer #1 bus #2-Newport (Duke) 230kV line	456	101	VC Summer New-Bush River (Duke) 230kV line and VC Summer New-Ward 230kV line
VC Summer #1 bus #2-Newport (Duke) 230kV line	456	101	VC Summer New-Bush River (Duke) 230kV line and VC Summer New-St George 230kV line

The installation of a series reactor on the VC Summer #1-Newport (Duke) 230kV line will reduce the current flow on the line and eliminate these conditions.

B. Short Circuit Analysis

The previously completed feasibility study indicated three 230kV breakers and eight 115kV breakers were overstressed due to the additional generation at V. C. Summer and must be replaced. This analysis identified no overstressed breakers due to the additional generation that had not already been previously identified in the Feasibility study.

The addition of the VC Summer #3 unit will increase the fault current in the VC Summer area to the point where 80kA breakers will be approaching the point of becoming overstressed. As the fault current capability of the interconnected transmission system increases in the future, this will require breakers with larger interrupting capability.

C. Stability Analysis

1. Overview of Stability Analysis.

The stability study of the connection of the V.C. Summer #3 AP1000 generator to the SCE&G transmission system assessed the ability of this generator to remain in synchronism following selected transmission system contingencies. Also reviewed were the adequacy of damping of generation/transmission oscillations and the impact of the proposed generator on the stability performance of other system generators. System voltage responses were examined for indications of voltage instability. In addition, generator frequency responses and the effects of protective system performance were evaluated.

For the system peak load cases, the adjacent V.C. Summer #2 generator was simulated as switched off except for where noted as otherwise. In addition, the 230kV transmission line connecting the V.C. Summer #3 generator switchyard to SCE&G'S Denny Terrace substation was switched out. These outages were simulated in order to account for the possibility that major generation and transmission could be out of service during the operation of the connecting facility. Power flow studies showed that these were the generation and transmission outages that resulted in the greatest impact on the reactive output of the V.C. Summer #3 generator.

Rotor angle responses of the V.C. Summer #3 generator were simulated in order to determine if angular instability could result from likely contingencies. Generator frequency deviations were examined in order to determine if generator frequency protection could result in generator tripping. The results of the loss of the V.C. Summer #3 generator were examined in order to determine if any resulting underfrequency relay operations would lead to system load shedding. Finally, the effects of each contingency on the V.C. Summer #2 & #3 230kV switchyard bus were examined along with voltages at the existing V.C. Summer #1 230kV and 115kV Offsite Power Supply buses to determine if the voltage requirements of the Offsite Power Supply buses were violated. Generator response plots are not included but are available for review upon request.

An initial 30 second steady state simulation for the selected connection configuration was performed in order to establish that steady state conditions existed prior to fault conditions. The simulation of each contingency repeated the steady state condition for 1 second prior to introducing permanent fault conditions so that the responses could be compared to the initial steady state condition. In order to determine the effects on all system generators, contingencies were simulated under system peak load conditions and system valley load conditions.

Contingencies were selected in order to satisfy each of four categories as specified by NERC Reliability Standards TPL-001 through TPL-004. Although not included in this report, a stability study of this interconnection was also performed for the VCS #2 & VCS #3 Combined Operating License Application (COLA). The results of that study support the findings of this Interconnection Study.

The results of the stability analysis are described in the following sections and are summarized following the detailed results.

2. Results of Peak Load Stability Analysis.

A.1. Steady state conditions (NERC Category A condition)

The interconnection of the V.C. Summer #3 generator was shown to result in system steady state conditions. Generator rotor angles and frequencies showed no significant deviations through out the 30 second simulation. The voltage at the V.C. Summer #3 bus remained at 232.38kV during the simulation. The voltages at the 230kV and 115kV V.C. Summer #1 Offsite Power Supply buses were constant at 232.30kV and 117.65kV.

A.2. Normal clearing of a three phase fault on the V.C. Summer #2 generator terminal 26kV bus (NERC Category B-1 Contingency)

Following a 1 second steady state period, a permanent fault was simulated at the 26Kv side of the V.C. Summer #3 generator step up transformer. This results in the opening of the generator breaker 5 cycles after the appearance of the fault. Since the station service buses are normally served from the 26kV bus, this operation would result in the loss of the station service loads. However, the station fast transfer scheme switches these loads to the switchyard 230kV bus and allows the continued service of these loads.

Rotor angle oscillations were moderate and well damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and well damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

During the application of the fault, the voltage at the V.C. Summer #3 230Kv bus dropped to 119.42kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 121.436kV and 77.27kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 1 cycle of the clearing of the fault.

Steady state conditions were reestablished with no further system operations.

A.3. Delayed clearing of a single line to ground fault on the future V.C. Summer #2 & #3 switchyard to the existing V.C. Summer #1 generator switchyard bus #1 (NERC Category C-8 contingency)

Since this contingency places a fault near the existing V.C. Summer #1 generator and both future VCS #2 & #3 generators, these units were modeled as switched on. All local transmission lines were also modeled as in service. Following a 1 second steady state period, a permanent single phase-to-ground fault was simulated at the V.C. Summer #2 & #3 end of the V.C. Summer #2 & #3 – V.C. Summer #1 230kV transmission line #1. The circuit breaker at the V.C. Summer #1 end of the line was simulated as operating normally. The breaker and a half scheme at the V.C. Summer #2 & #3 switchyard cleared the fault following a fault duration of approximately 0.25 seconds.

During the application of the fault, the voltage at the V.C. Summer #2 & #3 bus dropped to 107.12kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 109.64kV and 62.11kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. The voltages did not recover in time to reset the loss of voltage relay timers within the required 0.24 seconds of the appearance of the fault. Consequently, both the 230kV and the 115kV loss of voltage relays will operate, resulting in a loss of offsite power and switching of the Engineered Safeguard Features 7.2kV buses to the diesel generators. This operation is not caused by the VCS #3 generator since any nearby fault with delayed clearing will depress the VCS#1 230kV switchyard and local 115kV transmission system voltages for a longer period of time than the VCS #1 loss of voltage relay timers are set for.

Rotor angle oscillations for local generators were pronounced but were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

A.4. Normal clearing of a three phase fault on the existing V.C. Summer #1 generator switchyard bus #1 (NERC Category D-10 contingency)

Following a 1 second steady state period, a permanent single three phase fault was simulated at the V.C. Summer #1 bus #1. Since this is the bus that the V.C. Summer #1 generator is connected to that generator was tripped when the fault was cleared. In addition, in order to prevent the Fairfield Pumped Storage generators from becoming unstable, a Special Protection System that was identified as needed when V.C. Summer #2 goes into service will need to be installed at the V.C. Summer #1 switchyard in order to trip those units as well. The operations to clear the fault and trip the generators will occur within 6 cycles from the appearance of the bus fault.

During the application of the fault, the voltage at the V.C. Summer #3 230kV bus dropped to 5.51kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 0.00kV and 34.47kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 9 cycles following the appearance of the fault.

Rotor angle oscillations were moderate and were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

3. Results of Light Load Stability Analysis.

A.1. Steady state conditions (NERC Category A condition)

The interconnection of the V.C. Summer #3 generator was shown to result in system steady state conditions. Generator rotor angles and frequencies showed no significant deviations through out the 30 second simulation. The voltage at the V.C. Summer #3 bus remained at 232.30kV during the simulation. The voltages at the 230kV and 115kV V.C. Summer #1 Offsite Power Supply buses were constant at 232.30kV and 117.88kV.

A.2. Normal clearing of a three phase fault on the V.C. Summer #3 generator terminal 26kV bus (NERC Category B-1 Contingency)

Following a 1 second steady state period, a permanent fault was simulated at the 26Kv side of the V.C. Summer #3 generator step up transformer. This results in the opening of the generator breaker 5 cycles after the appearance of the fault. Since the station service buses are normally served from the 26kV bus, this operation would result in the loss of the station service loads. However, the station fast transfer scheme switches these loads to the switchyard 230kV bus and allows the continued service of these loads.

Rotor angle oscillations were small but poorly damped due to the smaller level of synchronizing torque within the system due to the reduced amount of generation on line during system low load conditions. However, the generator rotor angle oscillations were eventually damped and there was no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also small and poorly damped but with no indication of system underfrequency load shedding or generator under/overfrequency operations.

During the application of the fault, the voltage at the V.C. Summer #3 bus dropped to 125.70kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 127.60kV and 72.95kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the timers within 1 cycle of the clearing of the fault.

Steady state conditions were reestablished with no further system operations.

A.3. Delayed clearing of a single line to ground fault on the future V.C. Summer #2 & #3 switchyard to the existing V.C. Summer #1 generator switchyard bus #2 (NERC Category C-8 contingency)

Following a 1 second steady state period, a permanent single phase-to-ground fault was simulated at the V.C. Summer #2 & #3 end of the V.C. Summer #2 & #3 – V.C. Summer #1 230kV transmission line #1. The circuit breaker at the V.C. Summer #1 end of the line was simulated as operating normally. The breaker and a half scheme at the V.C. Summer #2 & #3 switchyard cleared the fault following a fault duration of approximately 0.25 seconds.

During the application of the fault, the voltage at the V.C. Summer #2 & #3 bus dropped to 98.93kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 101.03kV and 60.79kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. The voltages did not recover in time to reset the loss of voltage relay timers within the required 0.24 seconds of the appearance of the fault. Consequently, both the 230kV and the 115kV loss of voltage relays will operate, resulting in a loss of offsite power and switching of the Engineered Safeguard Features 7.2kV buses to the diesel generators. This operation is not caused by the VCS #3 generator since any nearby fault with delayed clearing will depress the VCS #1 230kV switchyard and local 115kV transmission system voltages for a longer period of time than the VCS #1 loss of voltage relay timers are set for.

Rotor angle oscillations were large and were poorly damped due to the reduced generation during light load conditions and the resulting reduction in system synchronizing torque. An extended simulation showed that the generator rotor angle oscillations were eventually damped and there was no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

A.4. Normal clearing of a three phase fault on the existing V.C. Summer #1 generator switchyard bus #1 (NERC Category D-10 contingency)

Following a 1 second steady state period, a permanent three phase fault was simulated at the V.C. Summer #1 bus #1. Since this is the bus that the V.C. Summer #1 generator is connected to, that generator was tripped when the fault was cleared. In addition, in order to prevent the Fairfield Pumped Storage generators from becoming unstable, a Special Protection System that was identified as needed when V.C. Summer #2 goes into service will need to be installed at the V.C. Summer #1 switchyard in order to trip those units as well. The operations to clear the fault and trip the generators will occur within 6 cycles from the appearance of the bus fault.

During the application of the fault, the voltage at the V.C. Summer #2 230kV bus dropped to 5.84kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 0.00kV and 19.93kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. However, the voltages recovered enough to reset the loss of voltage relay timers within 13-14 cycles of the appearance of the fault. The voltage recovery allowed the degraded voltage relay timers to reset within 29-32 cycles following the fault.

Rotor angle oscillations were moderate and were adequately damped with no indication of angular instability. There was no indication of voltage instability. Likewise, system frequency responses were also moderate and adequately damped with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations. The plots for this case are shown in

A.5. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #2 to Fairfield Pumped Storage Generators # 5-8 (NERC Category D-11 contingency)

Following a 1 second steady state period, a permanent three phase fault was simulated on the 230kV transmission line that connects the V.C. Summer #1 bus #2 to the Fairfield Pumped Storage units #5-8. When this line was opened these units which were operating in the pumping mode were taken off line. This represents the loss of a large load removed from the system as a result of a single event.

During the application of the fault, the voltage at the V.C. Summer #2 230kV bus dropped to 5.97kV. The V.C. Summer #1 230kV and 115kV Offsite Power Supply bus voltages dropped to 0.00kV and 20.21kV respectively. This allowed the degraded voltage and loss of voltage relay timers to initiate. The voltage recovery differed between the 230kV and 115kV Offsite Power Supply buses but was sufficient to allow all relay timers to reset to prevent the switching of the Engineered Safeguard Features buses from the Offsite Power Supply buses. Transmission system voltages showed poorly damped oscillations with a return to steady state conditions during an extended 60 second simulation.

Rotor angle oscillations were moderate but poorly damped during the 30 second simulation due to the reduced system synchronizing torque during reduced system load conditions. However, an extended simulation to 60 seconds demonstrated an eventual return to steady state conditions. Switching the power system stabilizer at V.C. Summer #3 did not noticeably degrade the rotor angle damping. There was no indication of angular instability. Likewise, system frequency responses were also poorly damped but with no indication of system underfrequency load shedding or generator under/overfrequency operations.

Steady state conditions were reestablished with no further system operations.

V.C. Summer #3 STABILITY STUDY RESULTS
Peak System Load Cases

A.1. Steady state conditions
- A. Generator rotor angles demonstrate steady state condition.
- B. There was no indication of voltage instability.
- C. Generator frequencies show no deviation.
- D. No negative impact on existing V.C. Summer #1 offsite power.
- E. NERC Reliability Standard TPL-001 compliance demonstrated.

A.2. Three phase fault with normal clearing on the V.C. Summer #3 generator terminal 26kV bus
- A. Moderate rotor angle oscillation for system generators with good damping and no indication of instability.
- B. There was no indication of voltage instability.
- C. Generator frequency responses are moderate and well damped with no system UFLS or generator under/over frequency operations.
- D. No negative impact on existing V.C. Summer #1 offsite power.
- E. NERC Reliability Standard TPL-002 compliance demonstrated.

A.3. Single line to ground fault with delayed clearing on the future V.C. Summer #3 switchyard to the existing V.C. Summer #1 generator switchyard bus #2
- A. Pronounced rotor angle oscillation for local generators with good damping and no system instability.
- B. There was no indication of voltage instability.
- C. Generator frequency responses are moderate and well damped with no system UFLS or generator under/over frequency operations.
- D. Loss of offsite power to V.C. Summer #1 Engineered Safeguard Features 7.2kV buses not due to V.C. Summer #3 generator.
- E. NERC Reliability Standard TPL-003 compliance demonstrated.

A.4. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #1
- A. Moderate rotor angle oscillation for system generators with adequate damping.
- B. There was no indication of voltage instability.
- C. Generator frequency responses are moderate and well damped with no system UFLS or generator under/over frequency operations.
- D. Special Protection System to trip Fairfield Pumped Storage #1-8 required as previously identified for V.C. Summer #2 generator.
- E. No negative impact on existing V.C. Summer #1 offsite power.
- F. NERC Reliability Standard TPL-004 compliance demonstrated.

V.C. Summer #3 STABILITY STUDY RESULTS
System Light Load Cases

A.1. Steady state conditions
   A. Generator rotor angles demonstrate steady state condition.
   B. There was no indication of voltage instability.
   C. Generator frequencies show no deviation.
   D. No negative impact on existing V.C. Summer #1 offsite power.
   E. NERC Reliability Standard TPL-001 compliance demonstrated.

A.2. Three phase fault with normal clearing on the V.C. Summer #3 generator terminal 26kV bus
   A. Small rotor angle oscillation for system generators with poor but adequate damping.
   B. There was no indication of voltage instability.
   C. Generator frequency oscillations small with poor but adequate damping.
   D. No negative impact on existing V.C. Summer #1 offsite power.
   E. NERC Reliability Standard TPL-002 compliance demonstrated.

A.3. Single line to ground fault with delayed clearing on the future V.C. Summer #3 switchyard to the existing V.C. Summer #1 generator switchyard bus #2
   A. Large rotor angle oscillation for system generators with poor damping.
   B. There was no indication of voltage instability.
   C. Generator frequency oscillations moderate with adequate damping.
   D. Loss of offsite power to V.C. Summer #1 Engineered Safeguard Features 7.2kV buses not due to V.C. Summer #3 generator.
   E. NERC Reliability Standard TPL-003 compliance demonstrated.

A.4. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #1
   A. Moderate rotor angle oscillation for system generators with adequate damping.
   B. There was no indication of voltage instability.
   C. Generator frequency oscillations moderate and adequately damped.
   D. Special Protection System to trip Fairfield Pumped Storage #1-8 required previously identified for V.C. Summer #2 generator.
   E. No negative impact on existing V.C. Summer #1 offsite power.
   F. NERC Reliability Standard TPL-004 compliance demonstrated.

A.5. Three phase fault with normal clearing on the existing V.C. Summer #1 generator bus #2 to Fairfield Pumped Storage Generators #5-8
   A. Moderate rotor angle oscillation for SCE&G generators with poor damping due to reduced system synchronizing torque during low system load conditions.
   B. There was no indication of voltage instability.
   C. Generator frequency oscillations moderate but poorly damped.
   D. No negative impact on existing V.C. Summer #1 offsite power.
   E. NERC Reliability Standard TPL-004 compliance demonstrated.

4. Stability Study Conclusions

This study demonstrates that the proposed V.C. Summer #3 generator interconnection to the SCE&G system is compliant with NERC Reliability Standards. There was no indication of voltage instability. None of the simulations indicated that system UFLS or generator under/overfrequency operations would occur. Neither does the interconnection have a negative impact on the existing V.C. Summer #1 offsite power quality. The cases that resulted in the loss of offsite power for the V.C. Summer #1 generator were caused by delayed clearing relay settings and not by the V.C. Summer #3 generator. Several cases with faults located near the V.C. Summer #1 and the Fairfield Pumped Storage units confirmed the need for a Special Protection System that will trip the Fairfield units to prevent instability. The need for this Special Protection System was identified during the V.C. Summer #2 System Impact Study. The SCE&G Relay and SCADA Applications department has identified the operating features of such a scheme and will make the required system protection improvements.

III. <u>Required Interconnection Facilities</u>

The analyses performed in this study confirmed the results of the Feasibility Study and show that constructing two new 230kV lines from the proposed VC Summer #3 generator to near the Charleston area load center, plus additional transmission improvements described below, are required to reliably transmit SCE&G's ownership portion of the 1,165 MW of the proposed VC Summer #3 generator from the VC Summer area to the remainder of the SCE&G system. Additionally, the off-peak analysis identified the need for a series reactor on the VC Summer #1-Newport (Duke) 230kV line to limit the power flow on that line.

The required transmission improvements:

1. Construct VC Summer New-St George 230kV Double Circuit B1272 line (135 mi)
   (Add 2 230kV terminals at VC Summer New using breaker-and-a-half design)

2. Construct VC Summer New-VC Summer #1 Bus #1
   (Add 230kV terminal at existing VC Summer #1 Bus #1)
   (Add 230kV terminal at VC Summer New using breaker-and-a-half design)

3. Establish a St George 230kV Substation using breaker-and-a-half design
   (6 terminals - 9 breakers)
   (Future 2 terminals - 3 breakers)
   (Add land)

4. Fold-in the Canadys-Santee 230kV line at St George 230kV

5. Upgrade the Canadys-St George 230kV line to B1272
   (Upgrade Canadys terminal)

6. Fold-in the Wateree-Summerville 230kV line at St George 230kV

7. Upgrade the St George-Summerville 230kV line to B1272
   (Upgrade Summerville terminal)

8. Upgrade Saluda-Georgia Pacific 115kV Double Circuit line to 1272
   (Upgrade Saluda terminal)

9. Install a 230kV Series Reactor (25% on a 500 MVA base) on the VC Summer #1-Newport (Duke) 230kV line

Add six (6) terminals (8 breakers) to the VC Summer New substation using breaker-and-a-half design.

10. One - for VC Summer #3 generator step up transformer
11. One - for VC Summer #3 station service

12. One - for the new 230kV line to the existing VC Summer #1 bus #1
13. Two - for the 2 new 230kV lines to St George 230kV
14. One - for the new 230kV line to Sandy Run (Santee Cooper)

To resolve overstressed conditions of the breakers as described in the Short Circuit Analysis section, Transmission Planning recommends replacing the following breakers with higher interrupting capability breakers:

Location	Voltage	Breaker #
VC Summer #1	230	8822
VC Summer #1	230	8932
VC Summer #1	230	8902
Lyles	115	732
Edenwood	115	3052
Dunbar	115	1112
A.M. Williams	115	5712
St. George	115	5002
St. George	115	5022
St. George	115	5052
St. George	115	5082

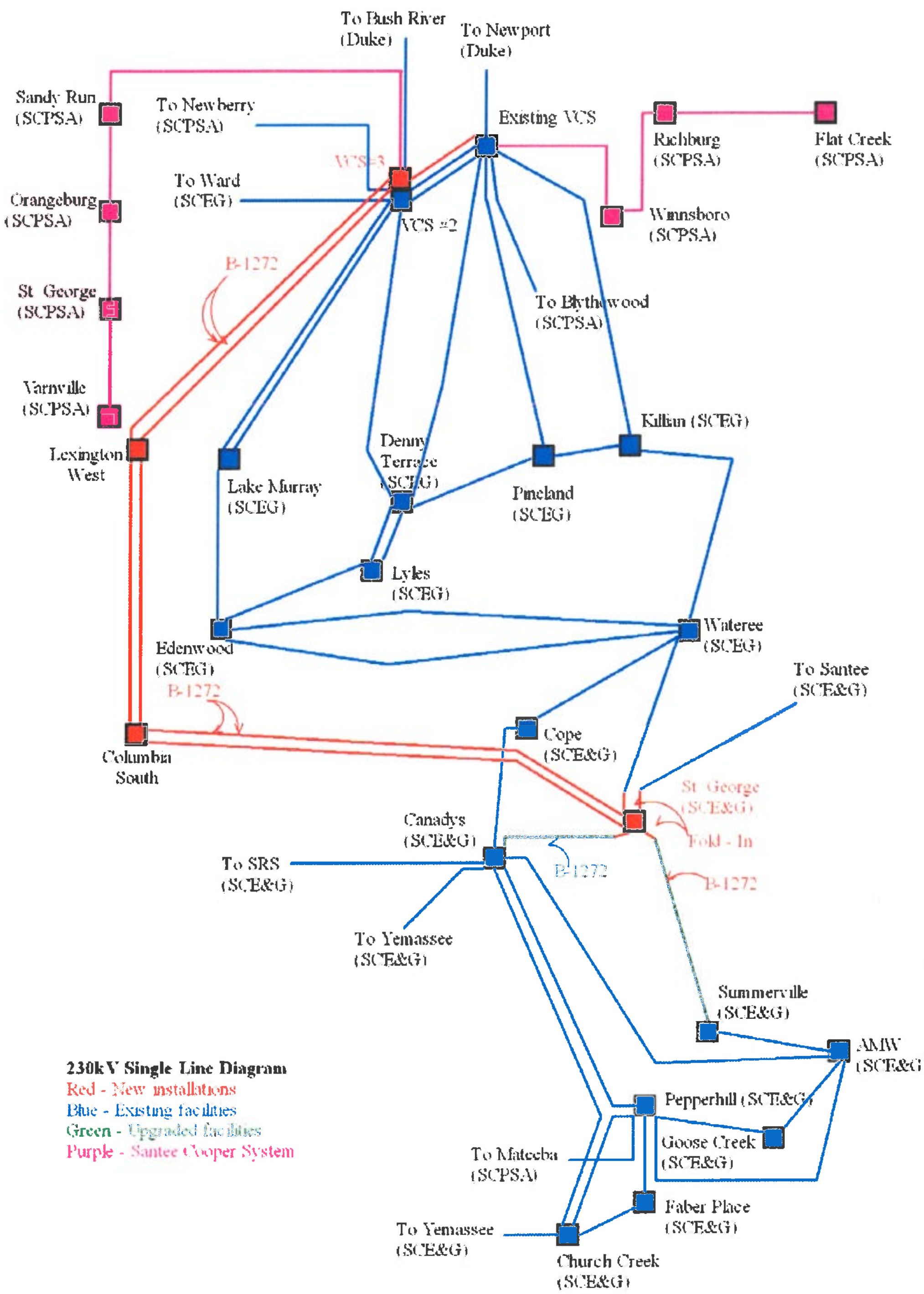
As stated in the stability analysis section, several cases with faults located near the VC Summer #1 and the Fairfield Pumped Storage units revealed a need for a Special Protection System that will trip the Fairfield units to prevent instability. The SCE&G Relay and SCADA Applications department has identified the operating features of such a scheme and will make the required system protection improvements.

IV. Engineering Design & Cost

A. Engineering Single line Layout & Substation Arrangement

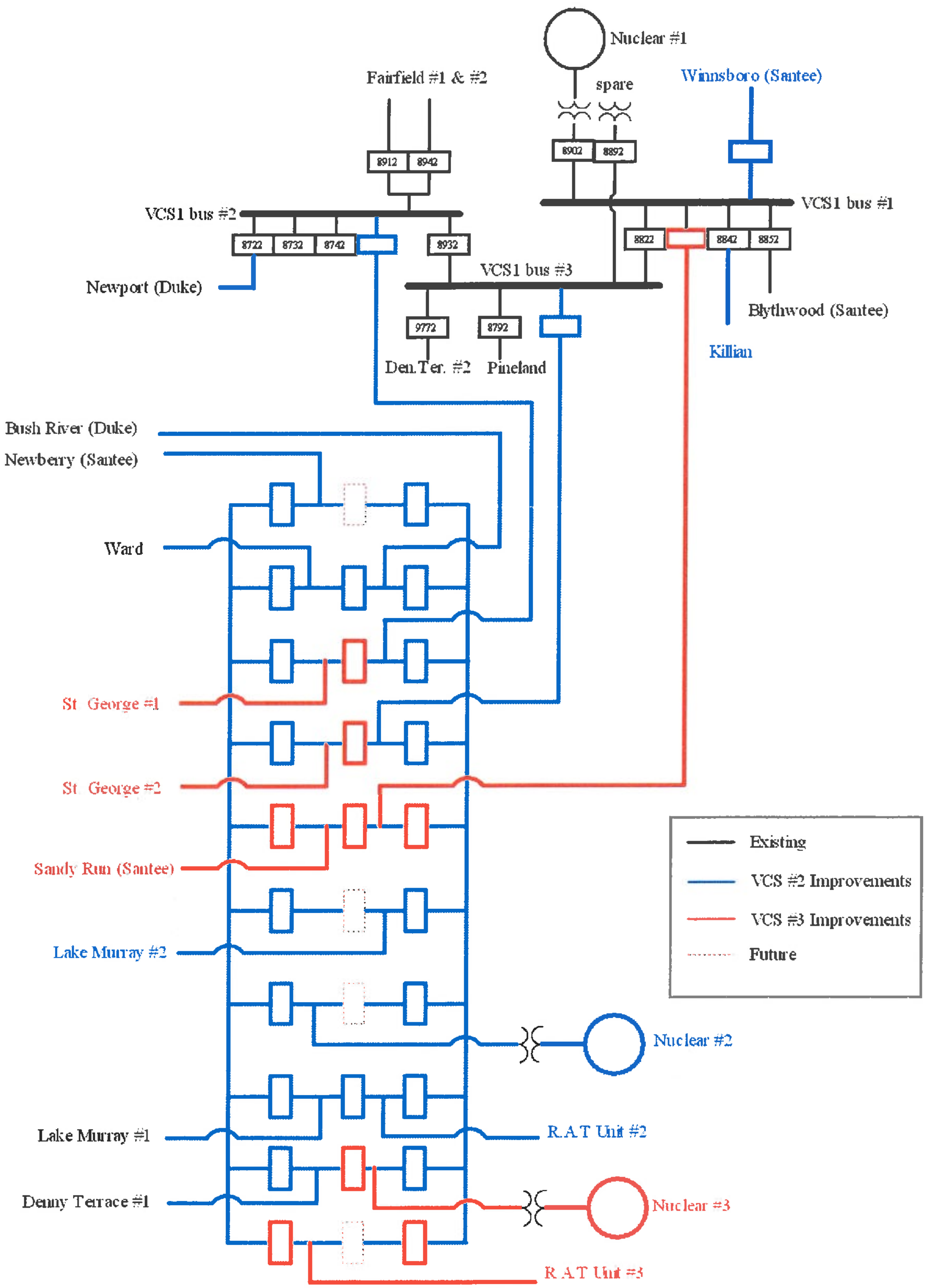
VC Summer #3

Transmission Single Line



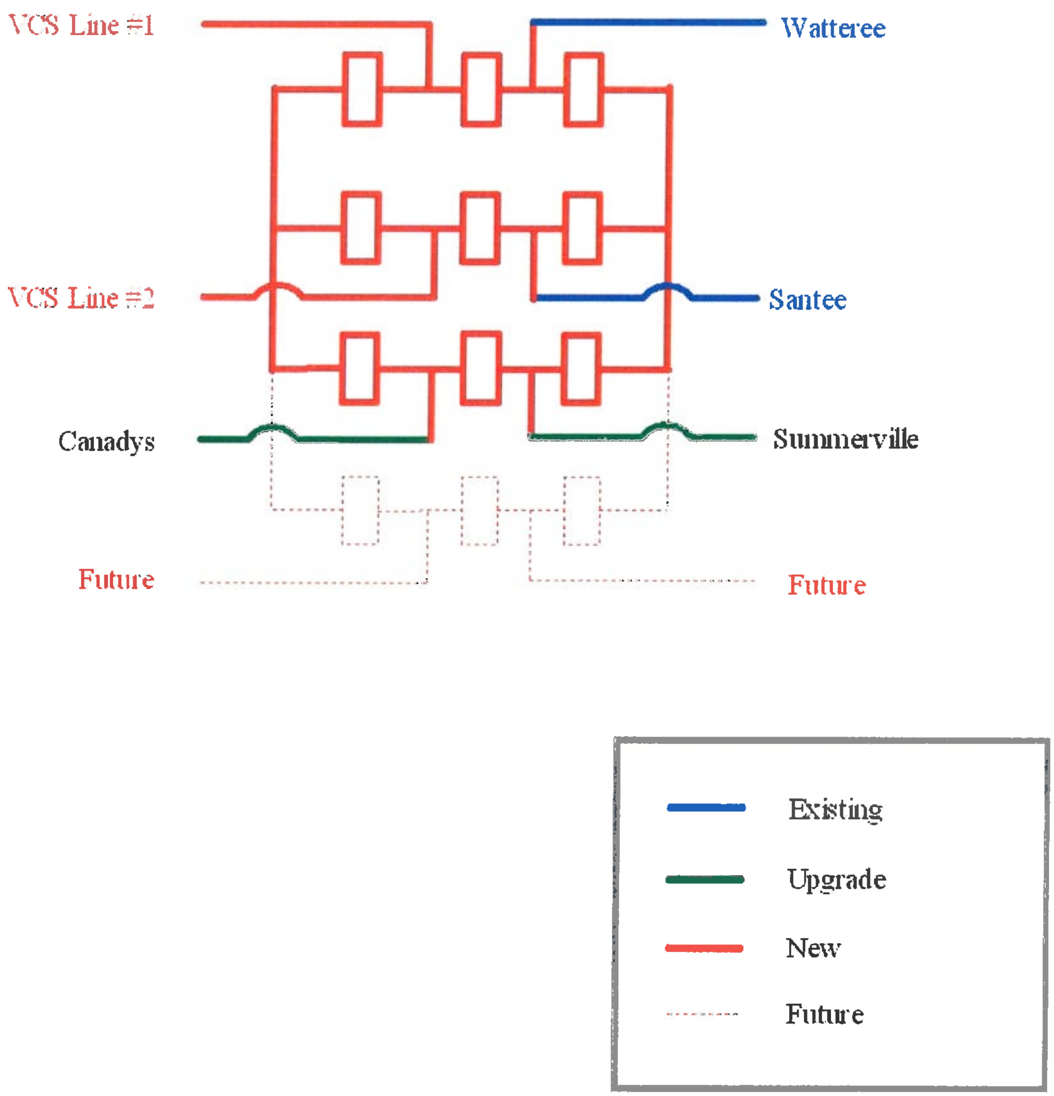
Substation Arrangement

VC Summer #3



Substation Arrangement

St George 230kV



B. Transmission & Substation Cost

All cost estimates are in 2006 dollars.

1. Construct VC Summer New-St George 230kV
   Double Circuit B1272 line (135 miles) $153,950,000

2. Construct VC Summer New-VC Summer #1 Bus #1)...........................$600,000
   (Add 230kV terminal at existing VC Summer #1 Bus #1).............$1,100,000

3. Construct St George 230kV Substation using
   breaker-and-a-half design $11,400,000

4. Fold-in the Canadys-Santee 230kV line at St George 230kV............$1,100,000

5. Upgrade the Canadys-St George 230kV line to B1272 ....$7,300,000

6. Fold-in the Wateree-Summerville 230kV line at St George 230kV $1,100,000

7. Upgrade the St George to Summerville 230kV line to B1272...........$15,300,000

8. Upgrade Saluda-Georgia Pacific 115kV Double Circuit line to 1272 $11,900,000

9. Add six (6) 230kV terminals (8 breakers) at VC Summer New using
   breaker-and-a-half design $12,000,000

10. Install a 230kV Series Reactor (25% on a 500 MVA base) on the
    VC Summer #1-Newport (Duke) 230kV line.................................$3,800,000

Replace overstressed breakers

11. Three (3) 230kV breakers $660,000
12. Eight (8) 115kV breakers $1,200,000

Total Cost Estimate...$221,410,000

SCE&G
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Generator Interconnection Facilities Study

SCE&G V.C. Summer Nuclear #2

Prepared for:
SCE&G Nuclear Group

April 14, 2008

Prepared by:
SCE&G Transmission Planning

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Generator Interconnection Facilities Study

SCE&G V.C. Summer Nuclear #2

A Generator Interconnection Facilities Study is an extension of the previous Generation Interconnection System Impact Study, and specifies and estimates the cost of the equipment, engineering, procurement and construction work needed to implement the conclusions of the Interconnection System Impact Study in accordance with Good Utility Practice to physically and electrically connect the Interconnection Facility to the Transmission System. A Generator Interconnection Facilities Study also identifies the electrical switching configuration of the connection equipment, including, without limitation: the transformer, switchgear, meters, and other station equipment; the nature and estimated cost of any Transmission Provider's Interconnection Facilities and Network Upgrades necessary to accomplish the interconnection; and an estimate of the time required to complete the construction and installation of such facilities.

General Discussion

The SCE&G Nuclear Group has applied for interconnection of a new 1375 MVA nuclear generator near the existing V.C. Summer site. This new generator would be jointly owed by SCE&G and Santee Cooper, SCE&G would own 55% and Santee Cooper would own the remaining 45%. In this study Santee Cooper's portion of the generator output was represented as delivered to the Santee Cooper system.

The previously completed System Impact Study recommended the following transmission line improvements:

1. Construct VC Summer-WInnsboro- Killian 230kV
    - (add 230kV terminal at Killian)
2. Construct VC Summer-Lake Murray 230kV
    - (add 230kV terminal at Lake Murray)
3. Construct VC Summer #2-VC Summer #1 bus #2
    - (add 230kV terminal at VC Summer #1 bus #2)
4. Construct VC Summer #2-VC Summer #1 bus #3
    - (add 230kV terminal at VC Summer #1 bus #3)
5. Upgrade existing Denny Terrace-Lyles 230kV
6. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray
7. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace
8. Upgrade existing Saluda-McMeekin 115kV line
9. Upgrade existing Lake Murray-McMeekin 115kV line
10. Upgrade existing Lake Murray-Saluda 115kV
11. Add second 230kV bus tie breaker at Denny Terrace

Construct a new 230kV generator substation at the proposed site using a breaker-and-a-half design with ten 230kV terminals

Construct Transmission from VC Summer #2 Generator to VC Summer #2 Switchyard

Re-terminate VC Summer area lines to the VC Summer #2 Substation

1. Re-terminate Bush River (Duke) 230kV line to VC Summer #2 substation
2. Re- terminate Newberry (SCPSA) 230kV line to VC Summer #2 substation (paid by SCPSA)
3. Re-terminate Ward 230kV line to VC Summer #2 substation
4. Re-terminate Lake Murray 230kV #1 line to VC Summer #2 substation
5. Re-terminate Denny Terrace 230kV #1 line to VC Summer #2 substation

Re-terminate VC Summer area lines to the VC Summer #1 Substation

1. Re-terminate Blythewood (SCPSA) 230kV line to VCS bus #1 (paid by SCPSA)
2. Re-terminate Pineland 230kV line to VCS bus #3
3. Re-terminate Denny Terrace 230kV line #2 to VCS bus #3
4. Re-terminate Newport (Duke) 230kV line to VCS bus #2

Replace overstressed
1. 230kV breakers - 9
2. 115kV breakers - 9

In the future, SCE&G Transmission Planning will periodically review the results of this Interconnection Facilities Study to determine if the recommended transmission expansion and the associated cost estimates remain valid.

I. Generator Information

The generator design consists of a single nuclear unit and one step-up transformer. The generator unit will have a maximum gross MVA output capacity of 1,375 MVA and a maximum continuous net MW of 1,165 MW.

The generator design consists of the following information:

MVA – gross:	1375
MW – net:	1165
Power Factor:	between .90 and 1.05
Voltage:	22kV
Speed:	1800 rpm
X'd-sat.: 0.465 PU;	X"d-sat.: 0.325 PU
X2-sat.: 0.320 PU;	X0: 0.237 PU

II. Cost Estimates of Transmission Provider's Interconnection Facilities and Network Upgrades and Completion Dates

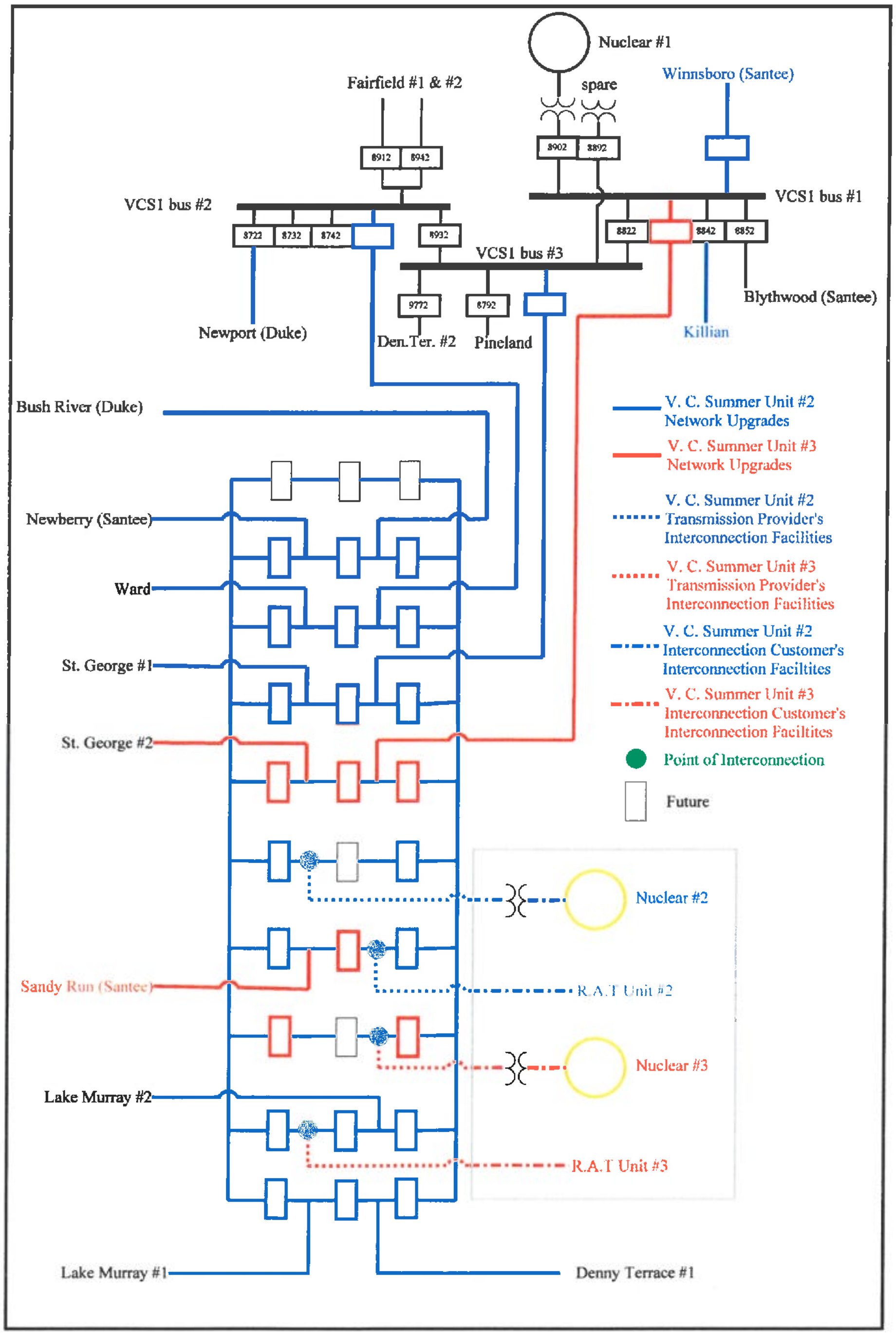
The Table below includes the cost estimate for the required Transmission Provider Interconnection Facilities, the required Network Upgrades and the estimated completion date for each of these required projects.

VC Summer Unit #2 Transmission Cost Estimates
Escalated at 4% per year from 2008

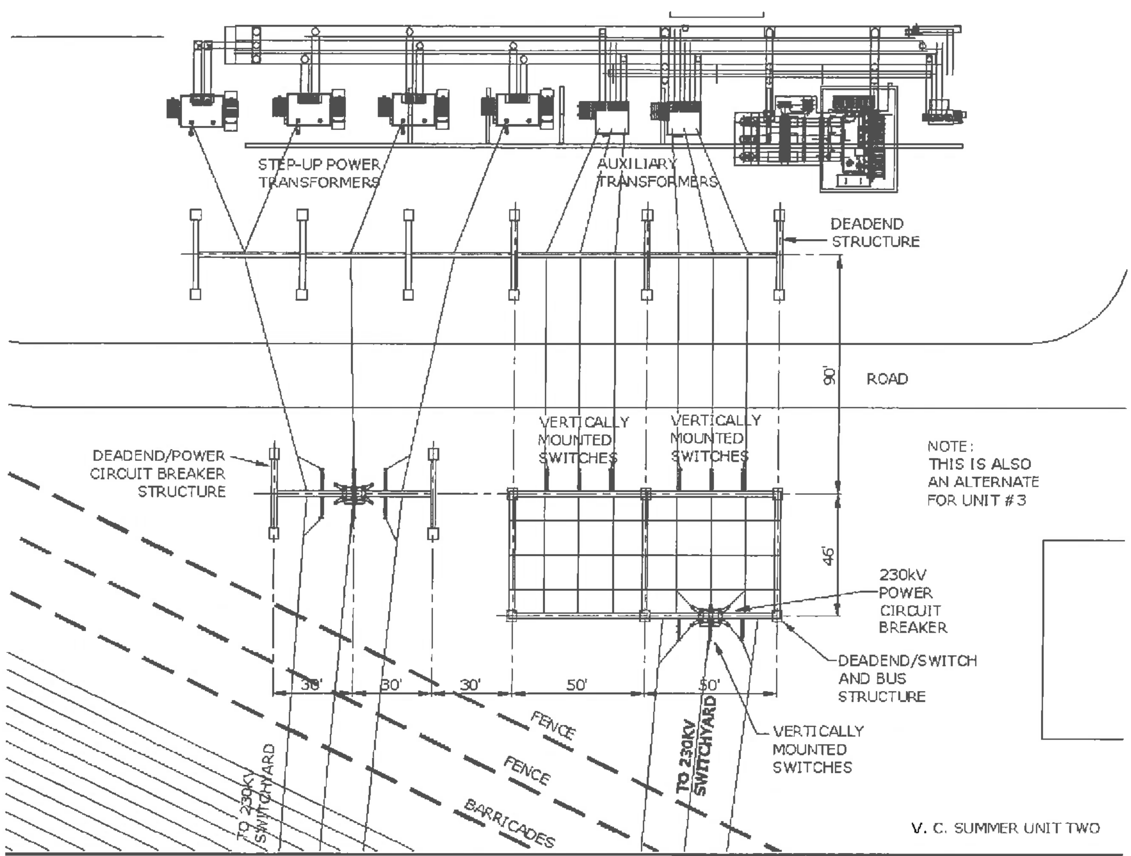
Project Name	Scheduled End Date	Budget 2008	Budget 2009	Budget 2010	Budget 2011	Budget 2012	Budget 2013	Budget 2014	Budget 2015	Budget 2016	Budget 2017	Budget 2018	Totals
Summer Unit #2 230KV Switchyard - Construct	12/31/2013				1,000,000	15,000,000	17,000,000		Budgeted in Nuclear				33,000,000
Summer #1-Killian -230KV Line - Construct B1272 (Estimate includes R/W. Assume rebuild of current H-frame for approx approx 24 miles single circuit single shaft – no additional R/W required and a single shaft single circuit for 3 miles. Assume additional R/W of 70ft alongside existing R/W from Pineland to Killian – approx 26 acres @ 80,000 per Acre)	12/31/2015					500,000	1,500,000	14,000,000	19,000,000				35,000,000
Killian Add 230KV Term – Summer-Construct	12/31/2015								840,000				840,000
VCS #2-Lake Murray Trans #2-230KV Line - Construct (assume rebuild of current H-frame approx 19 miles single circuit single shaft – no additional R/W required)	12/31/2015					800,000	3,000,000	10,000,000	10,000,000				23,800,000
Lake Murray Transmission: Add 230KV Term VCS#2	12/31/2015								840,000				840,000
Summer Unit #2-230KV Tie to Bus #2 - Construct (Assume 0.75 mile)	12/31/2013						840,000						840,000
Summer Unit #1 – Add 230KV Term to Bus #2 - Construct	12/31/2013						840,000						840,000
Summer Unit #2-230KV Tie to Bus #3 – Construct (Assume 0.75 mile)	12/31/2013						840,000						840,000
Summer Unit #1 – Add 230KV Term to Bus #3 - Construct	12/31/2013						840,000						840,000
Denny Terrace-Lyles 230KV – Rebuild to B1272 (Approx 2.75 mile)	12/31/2015							100,000	2,000,000				2,100,000
VC Sum Area: Reterminate 230kV lines to VCS #1 Sub	12/31/2013						950,000						950,000
VC Sum Area: Reterminate 230kV Lines to VCS #2 Sub	12/31/2013						1,800,000						1,800,000
Lake Murray Trans – Add 3rd 336 Autobank	12/31/2015							3,000,000	4,000,000				7,000,000
Denny Terrace – Add 3rd 336 Autobank / 230kV BT	12/31/2015							5,000,000	6,000,000				11,000,000
Saluda-McMeekin 115KV Line – Upgrade (Approx 0.2 mile)	12/31/2015						200,000						200,000
Lake MurrayTrans-McMeekin 115KV Line – Upgrade (Approx 0.6 mile)	12/31/2015								700,000				700,000
Lake Murray-Saluda 115KV Line Upgrade (Approx 0.5 mile)	12/31/2015								630,000				630,000
Various 115KV PRCB Upgrade Interrupter Rating (Assume 9 PRCBs)	12/31/2015							800,000	3,000,000				3,800,000
Various 230KV PRCB Upgrade Interrupter Rating (Assume 9 PRCBs)	12/31/2015							1,300,000	5,000,000				6,300,000
VC Summer Unit #2 to Unit #2 Sub 230kV Line: Const	12/31/2013						500,000						500,000
VC Summer RAT #2 to Unit #2 Sub 230kV Line: Constr	12/31/2013						500,000						500,000
VCS - Parr 115kV Safeguard Line: Raise for Unit 2	12/1/2009		70,000										70,000
VC Summer Sub: 230kV BB Bus Tie between #1 & #3	5/1/2009		250,000										250,000
		0	320,000	0	1,000,000	16,300,000	28,810,000	34,200,000	52,010,000	0	0	0	132,640,000

III. Facilities Classifications

The Facilities Study report must identify and estimate the cost of any Transmission Provider's Interconnection Facilities and Network Upgrades necessary to accomplish the interconnection. The diagram below includes color and line style indications of which facilities fall into the classification of Network Upgrades, Transmission Provider's Interconnection Facilities or Interconnection Customer's Interconnection Facilities. Cost estimates for all Network Upgrades and Transmission Provider's Interconnection Facilities are included in Section II of this report. *The diagram below is different from the diagram in the System Impact Study and reflects the most recent substation design.*



IV. Electrical Switching Configuration



Generator Interconnection Facilities Study

SCE&G V.C. Summer Nuclear #3 – Revision #2

Prepared for:
SCE&G Nuclear Group

April 10, 2008
May 27, 2008 – Revision #1
May 29, 2008 – Revision #2

Prepared by:
SCE&G Transmission Planning

May 29, 2008 – Revision #2
This revision renames and rearranges one of the associated projects in the narrative and in the cost estimate table for clarification. The rest of the report is unchanged and included in its entirety.

May 27, 2008 – Revision #1
This report corrects a double entry line item in the cost estimate for the VC Summer #3 interconnection. The rest of the report is unchanged and included in its entirety.

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Generator Interconnection Facilities Study

SCE&G V.C. Summer Nuclear #3

A Generator Interconnection Facilities Study is an extension of the previous Generation Interconnection System Impact Study, and specifies and estimates the cost of the equipment, engineering, procurement and construction work needed to implement the conclusions of the Interconnection System Impact Study in accordance with Good Utility Practice to physically and electrically connect the Interconnection Facility to the Transmission System. A Generator Interconnection Facilities Study also identifies the electrical switching configuration of the connection equipment, including, without limitation: the transformer, switchgear, meters, and other station equipment; the nature and estimated cost of any Transmission Provider's Interconnection Facilities and Network Upgrades necessary to accomplish the interconnection; and an estimate of the time required to complete the construction and installation of such facilities.

General Discussion

The SCE&G Nuclear Group has applied for interconnection of a new 1375 MVA nuclear generator near the existing V.C. Summer site. This new generator would be the third nuclear generator on this site and would be jointly owned by SCE&G and Santee Cooper, SCE&G would own 55% and Santee Cooper would own the remaining 45%. In this study Santee Cooper's portion of the generator output was represented as delivered to the Santee Cooper system.

The previously completed System Impact Study for VC Summer #3 recommended the following transmission line improvements:

1. 230KV Switchyard Additions for Unit #3 - Add six (6) 230kV terminals (8 breakers) at VC Summer New using breaker-and-a-half design
2. Construct VC Summer New-St George 230kV Double Circuit B1272 line (135 miles)
3. Construct VC Summer New-VC Summer #1 Bus #1)
   (Add 230kV terminal at existing VC Summer #1 Bus #1)
4. Construct St George 230kV Substation using breaker-and-a-half design
5. Fold-in the Canadys-Santee 230kV line at St George 230kV
6. Upgrade the Canadys-St George 230kV line to B1272
7. Fold-in the Wateree-Summerville 230kV line at St George 230kV
8. Upgrade the St George to Summerville 230kV line to B1272
9. Upgrade Saluda-Georgia Pacific 115kV Double Circuit line to 1272
10. Install a 230kV Series Reactor (25% on a 500 MVA base) on the VC Summer #1-Newport (Duke) 230kV line

Replace overstressed breakers

11. Three (3) 230kV breakers
12. Eight (8) 115kV breakers

In the future, SCE&G Transmission Planning will periodically review the results of this Interconnection Facilities Study to determine if the recommended transmission expansion and the associated cost estimates remain valid.

I. Generator Information

The generator design consists of a single nuclear unit and one step-up transformer. The generator unit will have a maximum gross MVA output capacity of 1,375 MVA and a maximum continuous net MW of 1,165 MW.

The generator design consists of the following information:

MVA – gross:	1375
MW – net:	1165
Power Factor:	between .90 and 1.05
Voltage:	22kV
Speed:	1800 rpm
X'd-sat.: 0.465 PU;	X"d-sat.: 0.325 PU
X2-sat.: 0.320 PU;	X0: 0.237 PU

II. Cost Estimates of Transmission Provider's Interconnection Facilities and Network Upgrades and Completion Dates

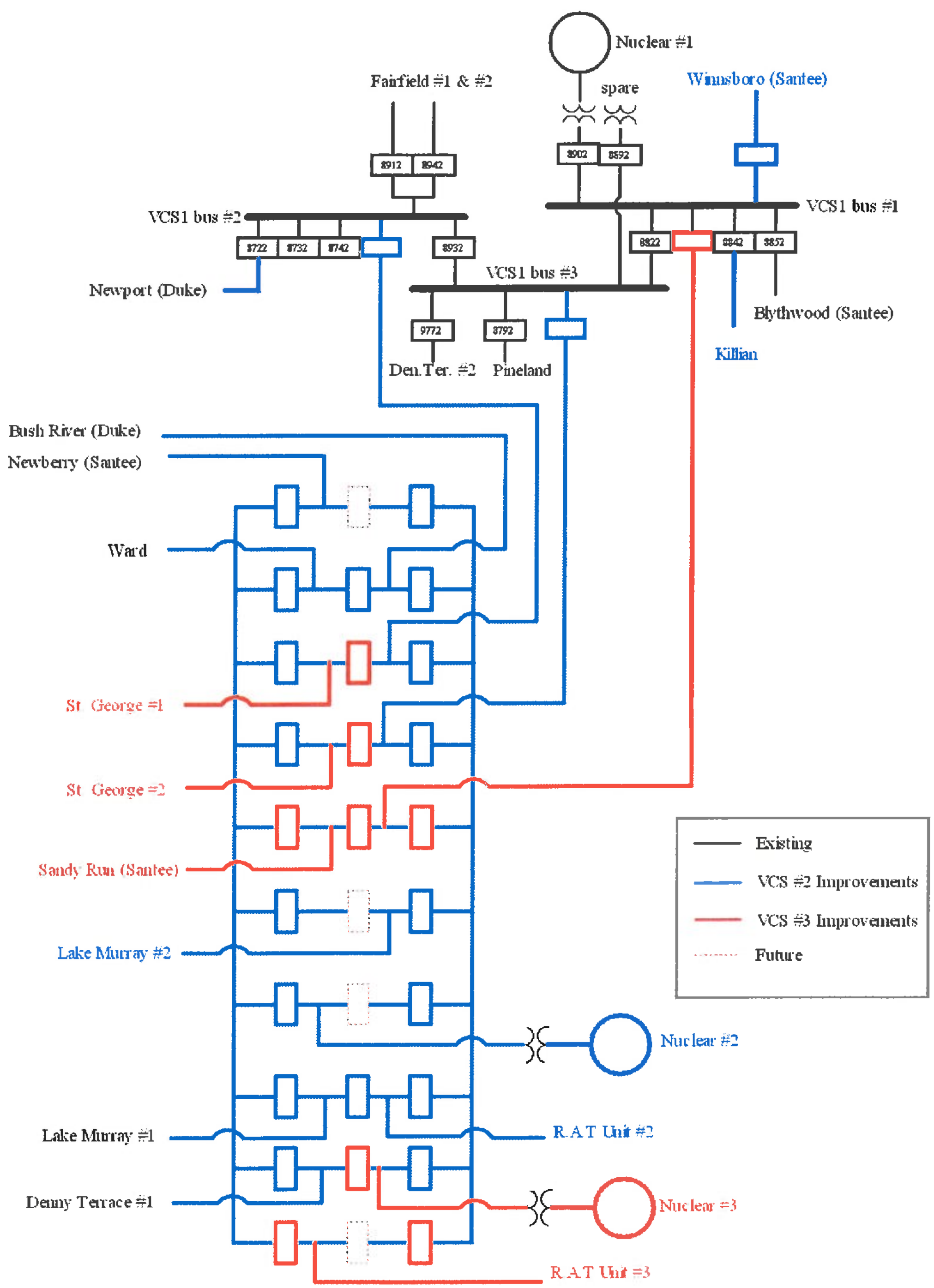
The Table below includes the cost estimate for the required Transmission Provider Interconnection Facilities, the required Network Upgrades and the estimated completion date for each of these required projects.

VC Summer Unit #3 Transmission Cost Estimates
Escalated at 4% per year from 2008

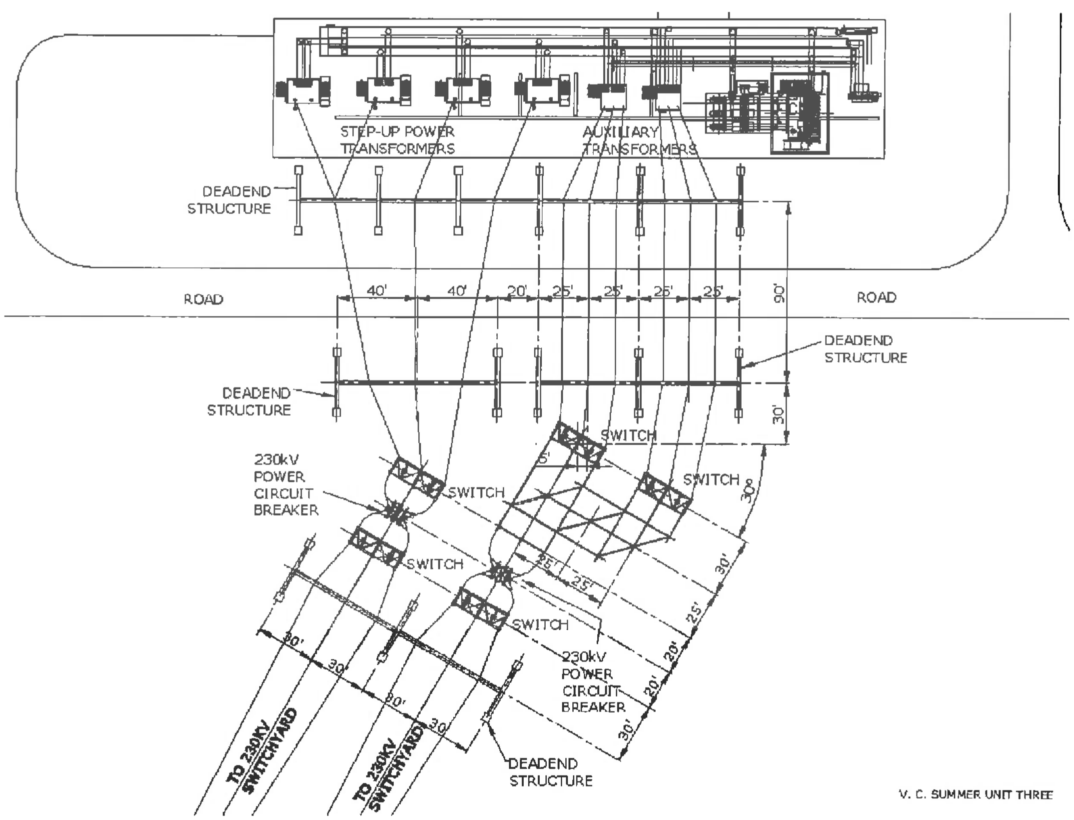
Project Name	Scheduled End Date	Budget 2008	Budget 2009	Budget 2010	Budget 2011	Budget 2012	Budget 2013	Budget 2014	Budget 2015	Budget 2016	Budget 2017	Budget 2018	Totals
230KV Switchyard Additions for Unit #3 - Add six (6) 230kV terminals (8 breakers) at VC Summer New using breaker-and-a-half design	12/1/2018									700,000	6,400,000	11,800,000	**18,900,000**
VCS #2 to St. George 230kV - Construct b1272 line (135 miles)	12/1/2018								500,000	1,500,000	100,000,000	144,320,000	**246,320,000**
Summer Unit #3-230KV Tie to Bus #1 – Construct (Assume 0.75 mile)	12/1/2018											960,000	**960,000**
VCS #1, Bus #1: Add Term to VCS #2 Sub	12/1/2018											1,760,000	**1,760,000**
VC Summer Unit #3 to #2 Sub 230kV Line: Const	12/1/2018											600,000	**600,000**
VC Summer RAT #3 to #2 Sub 230kV Line: Constr	12/1/2018											600,000	**600,000**
St. George 230kV Switching Station: Const Brkr ½	12/1/2018									240,000	8,000,000	10,000,000	**18,240,000**
Canadys - Santee 230kV: Fold In to St. George 230kV	12/1/2018											1,760,000	**1,760,000**
Canadys - St. George 230kV: Upgrade to B1272	12/1/2018									680,000	4,000,000	7,000,000	**11,680,000**
Wateree - Sum'ville 230kV: Fold In to St. George 230kV	12/1/2018											1,760,000	**1,760,000**
St. George - Sum'ville 230kV: Upgrade to B1272	12/1/2018									480,000	8,000,000	16,000,000	**24,480,000**
Sal Hydro - Ga Pac 115kV Double Ckt: Upgd to 1272	12/1/2018									100,000	8,000,000	11,000,000	**19,100,000**
VCS #1 Sub: Add 230kV Series Reactor in Newport Duke Line	12/1/2018										1,100,000	5,000,000	**6,100,000**
Various 230KV PRCB Upgrade Interrupter Rating (Assume 3 PRCBs)	12/1/2018											1,056,000	**1,056,000**
Various 115KV PRCB Upgrade Interrupter Rating (Assume 8 PRCBs)	12/1/2018											1,920,000	**1,920,000**
		0	**0**	**0**	**0**	**0**	**0**	**0**	**500,000**	**3,700,000**	**135,500,000**	**215,536,000**	**355,236,000**

III. Facilities Classifications

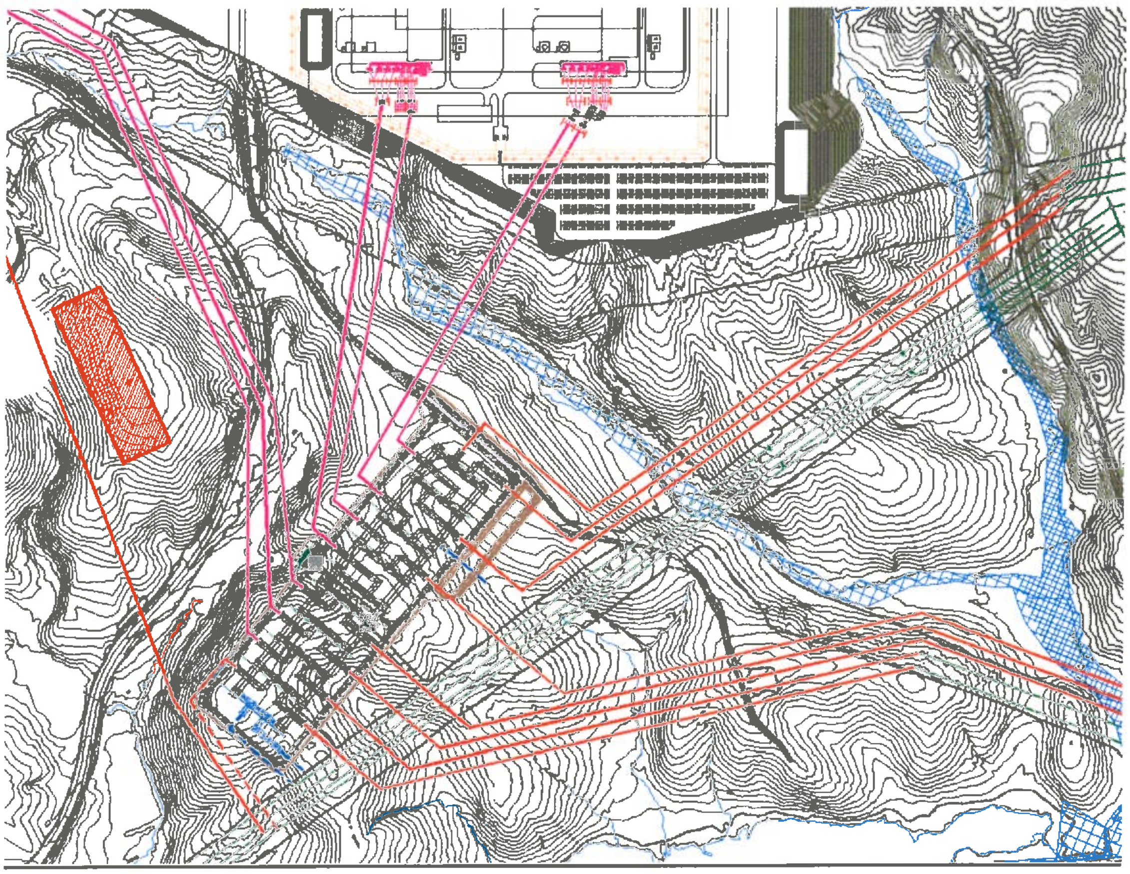
The Facilities Study report must identify and estimate the cost of any Transmission Provider's Interconnection Facilities and Network Upgrades necessary to accomplish the interconnection. The diagram below includes color coded indications of which facilities fall into the classification of Network Upgrades, Transmission Provider's Interconnection Facilities or Interconnection Customer's Interconnection Facilities. Cost estimates for all Network Upgrades and Transmission Provider's Interconnection Facilities are included in Section II of this report.



IV. Electrical Switching Configuration



V. **Facilities Diagram with VC Summer #2 and VC Summer #3**



SCE&G®
A SCANA COMPANY

Generator Interconnection Feasibility Study
For
SCE&G V.C. Summer Nuclear #2

Prepared for:
SCE&G Nuclear Group

August 4, 2006

Prepared by:
SCE&G Transmission Planning

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Generator Interconnection Feasibility Study for SCE&G V.C. Summer Nuclear #2

<u>Generator Interconnection Feasibility Studies</u> are intended to be preliminary studies to aid the requestor in determining if the application should advanced to additional, more detailed and more costly studies or be withdrawn. These additional studies include the System Impact Study, Optional Upgrade Studies and the Facility Study. Interconnection Feasibility Studies do not determine the final facilities and costs of interconnecting the requested generator to the existing transmission system.

General Discussion

The SCE&G Nuclear Group has applied for interconnection of a new 1375 MVA nuclear generator near the existing V.C. Summer site. This new generator would be jointly owed by SCE&G and Santee Cooper, SCE&G would own 55% and Santee Cooper would own the remaining 45%. In this study SCE&G simulated Santee Cooper's portion of the generator being delivered to the Santee Cooper system.

SCE&G Transmission Planning is participating in a joint study with Santee Cooper and other interconnected transmission providers to evaluate the effect of this generator and other planned generators in the region. Results of this joint study, such as short circuit, transient stability and power transfer capabilities, may affect the final recommendations included in this report.

The format of the report is as follows:

- I. Generator Information (provided by the SCE&G Nuclear Group)
- II. Transmission Studies
  - A. Power Flow Analysis
  - B. Short Circuit Analysis
- III. Preliminary Recommendations
- IV. General Engineering Design
- V. Cost Estimates

I. Generator Information

The generator design consists of a single nuclear unit and one step-up transformer. The generator unit will have a maximum gross MVA output capacity of 1,375 MVA and a maximum net MW of 1,165 MW.

The generator design consists of the following information:

MVA – gross:	1375
MW – net:	1165
Power Factor:	between .90 and 1.05
Voltage:	22kV
Speed:	1800 rpm
X'd-sat.: 0.465 PU;	X"d-sat.: 0.325 PU
X2-sat.: 0.320 PU;	X0: 0.237 PU

II. Transmission Studies

A. Power Flow Analysis

For the proposed generator interconnection of the VC Summer #2 generator, Transmission Planning performed analyses of:

1. Base case conditions (no outages) simulating normal conditions
2. N-1 conditions simulating single facility outages of each transmission facility on the SCE&G system
3. Selected n-2 conditions simulating the loss of two facilities on the SCE&G transmission system

This study is based on future projected conditions on the SCE&G transmission system, simulating 2015 peak summer conditions and assumes that the following transmission improvements will be made to SCE&G's Columbia area transmission system prior to 2015. These transmission improvements are currently scheduled and are needed for other system needs:

1. Upgrade Lyles-William Street 115kV line
2. Upgrade Lyles-Denny Terrace 115kV line #1 and #2
3. Add a 2nd Lake Murray 230/115kV auto transformer
4. Increase thermal rating on the Denny Terrace-Lyles 230kV line

Additionally, this study assumes that the following proposed transmission modifications will be made by Santee Cooper to their transmission system as part of their interconnection to the proposed generation. These transmission improvements were provided by Santee Cooper:

1. Add a VCS-Winnsboro 230kV line with 230/69kV transformers at Winnsboro.
2. Add a Winnsboro-Richburg 230kV line with 230/69kV transformers at Richburg.
3. Add a Richburg-Flat Creek 230kV line

<u>Run #1 – Injection of the proposed 1,165 MW at VC Summer 230kV with no affiliated transmission improvements</u>

For the initial analysis, 1,165 MW is injected at the VC Summer 230kV bus with no affiliated modifications to the SCE&G transmission system. With the existing VC Summer net generation of 966 MW and the Fairfield Pumped Storage net generation of 608 MW, the total net MW generation connected to the 230kV system in the vicinity of the VC Summer site is 2,739 MW.

<u>Base Case Conditions</u>
There are no overloaded facilities in the base case (no outages). However, several existing 230kV lines in the VC Summer area are highly loaded:

- The VCS-Pineland 230kV line loads to 75% of its 475 MVA Normal Rating
- The VCS-Denny Terrace 230kV line loads to 68% of its 475 MVA Normal Rating
- The VCS-Blythewood (Santee Cooper) 230kV line loads to 58% of its 478 MVA Normal Rating
- The VCS-Lake Murray 230kV line loads to 80% of its 704 MVA Normal Rating
- The Denny Terrace-Lyles 230kV line loads to 73% of its 475 MVA Normal Rating
- The Parr-Denny Terrace 230kV line loads to 66% of its 704 MVA Normal Rating.

N-1 Conditions
The n-1 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Overload (%)	Contingency
Parr-VC Summer 230kV line #1	636	103	Parr-VC Summer 230kV line #2
Parr-VC Summer 230kV line #2	636	103	Parr-VC Summer 230kV line #1
Denny Terrace-Lyles 230kV line	510	109	VC Summer-Lake Murray 230kV line

Selected N-2 Conditions
The n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Overload (%)	Contingency(s)
Parr-Denny Terrace 230kV line	755	111	VC Summer-Denny Terrace 230kV line and VC Summer-Lake Murray 230kV line
Parr-Denny Terrace 230kV line	755	110	VC Summer-Pineland 230kV line and VC Summer-Lake Murray 230kV line
Parr-Denny Terrace 230kV line	755	104	VC Summer-Pineland 230kV line and VC Summer-Denny Terrace 230kV line
VC Summer Parr 230kV line	636	135	Other VC Summer-Parr 230kV line and VC Summer-Lake Murray 230kV line
VC Summer Parr 230kV line	636	123	Other VC Summer-Parr 230kV line and VC Summer-Denny Terrace 230kV line
VC Summer Parr 230kV line	636	123	Other VC Summer-Parr 230kV line and VC Summer-Pineland 230kV line
VC Summer Parr 230kV line	636	112	Other VC Summer-Parr 230kV line and VC Summer-Blythewood 230kV line
VC Summer Parr 230kV line	636	110	Other VC Summer-Parr 230kV line and VC Summer-Winnsboro 230kV line
VC Summer Parr 230kV line	636	109	Other VC Summer-Parr 230kV line and VC Summer-Pomaria 230kV line

VC Summer Parr 230kV line	636	108	Other VC Summer-Parr 230kV line and VC Summer-Timberlake 230kV line
VC Summer Parr 230kV line	636	104-107	Other VC Summer-Parr 230kV line and one of various 230kV facilities in Columbia area.
Lyles-William Street 115kV line	255	116	VC Summer-Lake Murray 230kV line and Lyles-Edenwood 230kV line
Lyles 230/115kV auto transf	336	101	Denny Terrace 230/115kV auto transf #1 and Denny Terrace 230/115kV auto transf #2
VC Summer-Pineland 230kV line	510	130	Parr-Denny Terrace 230kV line and VC Summer-Lake Murray 230kV line
VC Summer-Pineland 230kV line	510	125	Parr-Denny Terrace 230kV line and VC Summer-Denny Terrace 230kV line
VC Summer-Pineland 230kV line	510	115	VC Summer-Denny Terrace 230kV line and VC Summer-Lake Murray 230kV line
VC Summer-Pineland 230kV line	510	101	Parr-Denny Terrace 230kV line and Wateree Generator or GSU
VC Summer-Pineland 230kV line	510	101	Parr-Denny Terrace 230kV line and Wateree-Huron 230kV line
VC Summer-Denny Terrace 230kV line	510	132	Parr-Denny Terrace 230kV line and VC Summer-Lake Murray 230kV line
VC Summer-Denny Terrace 230kV line	510	125	Parr-Denny Terrace 230kV line and VC Summer-Pineland 230kV line
VC Summer-Denny Terrace 230kV line	510	112	VC-Pineland 230kV line and VC Summer-Lake Murray 230kV line
VC Summer-Lake Murray 230kV line	755	111	Parr-Denny Terrace 230kV line and VC Summer-Denny Terrace 230kV line
VC Summer-Lake Murray 230kV line	755	111	Parr-Denny Terrace 230kV line and VC Summer-Pineland 230kV line
VC Summer-Lake Murray 230kV line	755	101	VC Summer-Denny Terrace 230kV line and VC Summer-Pineland 230kV line
Denny Terrace-Lyles 230kV line	510	105-130	VC Summer-Lake Murray 230kV line and one of various 230kV facilities in Columbia area.
Denny Terrace 230/115kV auto transf #1	336	133	Denny Terrace 230/115kV auto transf #2 and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #1	336	126	VC Summer-Lake Murray 230kV line and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #1	336	111	Lyles 230/115kV auto transf and Denny Terrace 230/115kV auto transf #2
Denny Terrace 230/115kV auto transf #1	336	107	VC Summer-Lake Murray 230kV line and Denny Terrace 230/115kV auto transf #2

Denny Terrace 230/115kV auto transf #2	336	132	Denny Terrace 230/115kV auto transf #1 and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #2	336	124	VC Summer-Lake Murray 230kV line and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #2	336	110	Lyles 230/115kV auto transf and Denny Terrace 230/115kV auto transf #1
Denny Terrace 230/115kV auto transf #2	336	106	VC Summer-Lake Murray 230kV line and Denny Terrace 230/115kV auto transf #1
Lake Murray 230/115kV auto transf #1	336	119	Lake Murray-Edenwood 230kV line and Lake Murray 230/115kV auto transf #2
Lake Murray 230/115kV auto transf #2	336	119	Lake Murray-Edenwood 230kV line and Lake Murray 230/115kV auto transf #1
Lake Murray-Saluda 115kV line	255	111	Bush River-Parr 230kV line and Saluda-McMeekin 115kV line
Saluda-McMeekin 115kV line	255	113	Bush River-Parr 230kV line and Lake Murray-Saluda 115kV line
Saluda-Whitehall 115kV line section	166	105	Lyles-William Street 115kV line and Coit-Vista South 115kV line

Run #2 – Rebuild Overloaded or highly loaded lower capacity lines

For Run #2, the following transmission modifications are made as a result of overloaded facilities that were identified in the Run #1 n-1 analyses:

1. Upgrade the Parr-VC Summer 230kV line #1 to B1272 conductor
2. Upgrade the Parr-VC Summer 230kV line #2 to B1272 conductor
3. Upgrade the Denny Terrace-Lyles 230kV line to B1272 conductor

Also, the Run #1 n-2 analyses showed that each of the four major transmission lines leaving the VC Summer area to the Columbia load center overload for the loss of various and paired combinations of the other three lines. We first addressed this by considering if upgrading the two lines with the lowest existing capacity is adequate:

5. Upgrade the VC Summer-Pineland 230kV line to B1272 conductor
6. Upgrade the VC Summer-Denny Terrace 230kV line to B1272 conductor

Base Case Conditions
There are no overloaded facilities in the Run #2 base case (no outages).

N-1 Conditions
There are no overloaded facilities in the Run #2 n-1 analyses due to the additional generation.

Selected N-2 Conditions

The Run #2 n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Overload (%)	Contingency(s)
Parr-Denny Terrace 230kV line	755	106	VC Summer-Denny Terrace 230kV line and VC Summer-Pineland 230kV line
Lyles-Williams Street 115kV line	255	121	VC Summer-Lake Murray 230kV line and Lyles-Edenwood 230kV line
Lyles-Williams Street 115kV line	255	101	VC Summer-Lake Murray 230kV line and Denny Terrace-Lyles 230kV line
Lyles 230/115kV auto transf	336	109	VC Summer-Lake Murray 230kV line and Lyles-Edenwood 230kV line
Lyles 230/115kV auto transf	336	110	Denny Terrace 230/115kV auto transf #1 and Denny Terrace 230/115kV auto transf #2
VC Summer-Lake Murray 230kV line	755	100	Parr-Denny Terrace 230kV line and VC Summer-Denny Terrace 230kV line
Denny Terrace 230/115kV auto transf #1	336	142	Denny Terrace 230/115kV auto transf #2 and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #1	336	131	VC Summer-Lake Murray 230kV line and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #1	336	115	Lyles 230/115kV auto transf and Denny Terrace 230/115kV auto transf #2
Denny Terrace 230/115kV auto transf #1	336	101	Denny Terrace-Lyles 230kV line and loss of one of three 115kV lines in the Pineland area
Denny Terrace 230/115kV auto transf #2	336	141	Denny Terrace 230/115kV auto transf #1 and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #2	336	129	VC Summer-Lake Murray 230kV line and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #2	336	114	Lyles 230/115kV auto transf and Denny Terrace 230/115kV auto transf #1
Denny Terrace 230/115kV auto transf #2	336	105	VC Summer-Lake Murray 230kV line and Denny Terrace 230/115kV auto transf #1
Lake Murray 230/115kV auto transf #1	336	119	Lake Murray-Edenwood 230kV line and Lake Murray 230/115kV auto transf #2
Lake Murray 230/115kV auto transf #2	336	119	Lake Murray-Edenwood 230kV line and Lake Murray 230/115kV auto transf #1

Lake Murray-Saluda 115kV line	255	110	Bush River-Parr 230kV line and Saluda-McMeekin 115kV line
Saluda-McMeekin 115kV line	255	111	Bush River-Parr 230kV line and Lake Murray-Saluda 115kV line

Run #3 – Rebuild Remaining two lines serving the Columbia load center

In Run #2, the Parr-Denny Terrace 230kV line and VC Summer-Lake Murray 230kV line both overload for n-2 contingencies in the Columbia area. The analyses in Run #2 show that both of these lines will require upgrading. Also, the overloading of the upgraded Parr-Denny Terrace 230kV line shows that a second Parr-Denny Terrace 230kV circuit is needed. In Run #3 the alternative of constructing a Parr-Denny Terrace 230kV line #2 with B1272 conductor and leaving the existing #1 line as 1272 conductor is evaluated. In addition, in Run #3 a 3rd Lake Murray 230/115kV auto transformer is added.

For Run #3, the following transmission modifications are made:

1. Upgrade the Parr-VC Summer 230kV line #1 to B1272 conductor.
2. Upgrade the Parr-VC Summer 230kV line #2 to B1272 conductor.
3. Add a new Denny Terrace-Lyles #2 230kV line (B1272)
4. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray.
5. Upgrade the VC Summer-Pineland 230kV line to B1272 conductor.
6. Upgrade the VC Summer-Denny Terrace 230kV line to B1272 conductor.
7. Upgrade the Parr-Denny Terrace 230kV line to B1272
8. Upgrade the VC Summer-Lake Murray 230kV line to B1272

Base Case Conditions
There are no overloaded facilities in the Run #3 base case (no outages).

N-1 Conditions
There are no overloaded facilities in the Run #3 n-1 analyses due to the additional generation.

Selected N-2 Conditions
The Run #3 n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Overload (%)	Contingency(s)
Lyles-Williams Street 115kV line	255	123	VC Summer-Lake Murray 230kV line and Lyles-Edenwood 230kV line
Lyles 230/115kV auto transf	336	114	VC Summer-Lake Murray 230kV line and Lyles-Edenwood 230kV line

Lyles 230/115kV auto transf	336	110	Denny Terrace 230/115kV auto transf #1 and Denny Terrace 230/115kV auto transf #2
Denny Terrace-Lyles 230kV #1 line	510	119	Denny Terrace-Lyles 230kV #2 line and VC Summer-Denny Terrace 230kV line
Denny Terrace 230/115kV auto transf #1	336	111	Lyles 230/115kV auto transf and Denny Terrace 230/115kV auto transf #2
Denny Terrace 230/115kV auto transf #1	336	103	VC Summer-Lake Murray 230kV line and Denny Terrace 230/115kV auto transf #2
Denny Terrace 230/115kV auto transf #2	336	110	Lyles 230/115kV auto transf and Denny Terrace 230/115kV auto transf #1
Denny Terrace 230/115kV auto transf #2	336	102	VC Summer-Lake Murray 230kV line and Denny Terrace 230/115kV auto transf #1
Lake Murray-Saluda 115kV line	255	117	Bush River-Parr 230kV line and Saluda-McMeekin 115kV line
Lake Murray-Saluda 115kV line	255	105	Lyles-Williams St 115kV line and Saluda-McMeekin 115kV line
Lake Murray-Saluda 115kV line	255	101	Lake Murray-Edenwood 230kV line and Saluda-McMeekin 115kV line
Saluda-McMeekin 115kV line	255	118	Lake Murray-Saluda 115kV line and Bush River-Parr 230kV line
Saluda-McMeekin 115kV line	255	106	Lake Murray-Saluda 115kV line and Lyles-William Street 115kV line
Saluda-McMeekin 115kV line	255	102	Lake Murray-Saluda 115kV line and Lake Murray-Edenwood 230kV line

Run #4 – Add two new lines serving the Columbia load center

Run #3 shows that upgrading all four 230kV lines from the VC Summer area to the Columbia Area load center along with several other transmission improvements is required to accommodate the additional VC Summer generation. However, upgrading these lines to B1272 will require the removal of the existing facilities resulting in the loss of the transmission capacity associated with these existing lines. Removal of these facilities and replacing them with new construction has the net effect of receiving only 50% of the capability of the new transmission improvements. Doing this even though there is significant capability and life remaining in the existing lines is not a cost effective practice.

In Run #4 we will evaluate adding a new VC Summer-Killian 230kV line and a new VC Summer-Lake Murray 230kV line.

Also, for Run #4 only one 230kV B1272 circuit between Lyles and Denny Terrace is considered.

For Run #4, the following transmission modifications are made:

1. Upgrade the Parr-VC Summer 230kV line #1 to B1272 conductor.
2. Upgrade the Parr-VC Summer 230kV line #2 to B1272 conductor.
3. Upgrade the Denny Terrace-Lyles 230kV line to B1272 conductor.
4. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray.
5. Add a VC Summer-Killian 230kV line with B1272 conductor
6. Add a VC Summer-Lake Murray 230kV #2 line with B1272 conductor

Base Case Conditions

There are no overloaded facilities in the Run #4 base case (no outages).

N-1 Conditions

The Run #4 n-1 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Overload (%)	Contingency
Saluda-McMeekin 115kV line	255	105	Lake Murray-Saluda 115kV line

N-2 Conditions

The n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Emergency Rating (MVA)	Overload (%)	Contingency(s)
Denny Terrace 230/115kV auto transf #1	336	115	Denny Terrace 230/115kV auto transf #2 and Denny Terrace-Lyles 230kV line
Denny Terrace 230/115kV auto transf #2	336	114	Denny Terrace 230/115kV auto transf #1 and Denny Terrace-Lyles 230kV line
Lake Murray-Saluda 115kV line	255	106-126	Saluda-McMeekin 115kV line or Lake Murray-McMeekin 115kV line and one of various other Columbia Area transmission facilities
Lake Murray-McMeekin 115kV line	255	104-111	Lake Murray-Saluda 115kV line or Saluda McMeekin 115kV line and one of various other Columbia Area transmission facilities
Saluda-McMeekin 115kV line	255	101-127	Lake Murray-Saluda 115kV line or Lake Murray-McMeekin 115kV line and one of various other Columbia Area transmission facilities

<u>Run #5 – Add the two new lines serving the Columbia load center and additional transmission improvements</u>

In Run #4, the loss of the Denny Terrace-Lyles 230kV line and one of the Denny Terrace 230/115kV auto transformers results in the remaining Denny Terrace 230/115kV auto transformer overloading. Adding a 3rd Denny Terrace 230/115kV auto transformer will correct this problem.

Also, upgrading the Lake Murray-Saluda 115kV line, the Lake Murray-McMeekin 115kV line and the Saluda-McMeekin 115kV line to B1272 conductor will eliminate the overloads on those lines.

For Run #5, the following transmission modifications are made:

1. Upgrade the Parr-VC Summer 230kV line #1 to B1272
2. Upgrade the Parr-VC Summer 230kV line #2 to B1272
3. Upgrade the Denny Terrace-Lyles 230kV line to B1272
4. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray
5. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace
6. Add a VC Summer-Killian 230kV line with B1272
7. Add a VC Summer-Lake Murray 230kV line #2 with B1272
8. Upgrade the existing Saluda-McMeekin 115kV line with B1272
9. Upgrade the existing Lake Murray-McMeekin 115kV line with B1272
10. Upgrade the existing Lake Murray-Saluda 115kV line with B1272

<u>Base Case Conditions</u>
There are no overloaded facilities in the Run #5 base case (no outages).

<u>N-1 Conditions</u>
There are no overloaded facilities in the Run #5 n-1 analyses due to the additional generation.

<u>Selected N-2 Conditions</u>
There are no overloaded facilities in the Run #5 n-2 analyses due to the additional generation.

B. Short Circuit Analysis

An initial review of the effect of the increased fault current in the VC Summer area due to the new generation and the required transmission facilities indicates that sixteen 230kV breakers (eleven at VC Summer and five at Parr) are projected to be overstressed. Additionally, nine 115kV breakers in the Columbia area are projected to become overstressed. Each of these overstressed breakers will need to be replaced with a higher capacity breaker.

III. Preliminary Recommendations

Proposed Transmission Improvements

The analyses performed in this study show that constructing two new 230kV lines from the proposed VCS #2 generator to the Columbia Area load center, plus additional transmission improvements described below, are required to reliably transmit the 1,165 MW of the proposed VC Summer #2 generator from of the VC Summer area to the remainder of the SCE&G system. Also, the analyses show that constructing two new 230kV lines is less costly and more effective than upgrading the numerous existing 230kV transmission facilities that currently transmit power from the VC Summer area.

The required transmission projects are:

1. Construct a new VC Summer-Killian 230kV line with B1272 conductor
   - (add 230kV terminal at Killian)
2. Construct a new VC Summer-Lake Murray 230kV line with B1272 conductor
   - (add 230kV terminal at Lake Murray)
3. Construct a new VC Summer-VC Summer (existing) Bus #2 230kV line with B1272 conductor
   - (add 230kV terminal at existing VC Summer Bus #2)
4. Construct a new VC Summer-VC Summer (existing) Bus #3 230kV line with B1272 conductor
   - (add 230kV terminal at existing VC Summer Bus #3)
5. Upgrade the existing Denny Terrace-Lyles 230kV line to B1272
6. Upgrade the existing Parr-VC Summer #1 230kV line to B1272
7. Upgrade the existing Parr-VC Summer #2 230kV line to B1272
8. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray
9. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace
10. Upgrade the existing Saluda-McMeekin 115kV line to B1272
11. Upgrade the existing Lake Murray-McMeekin 115kV line to B1272
12. Upgrade the existing Lake Murray-Saluda 115kV to with B1272

Construct a new 230kV generator substation at the proposed site using a breaker-and-a-half design with seven 230kV terminals.

1. One - for the generator step up transformer
2. One - for station service
3. One - for the new 230kV line to the existing V. C. Summer 230kV bus #2
4. One - for the new 230kV line to the existing V. C. Summer 230kV bus #3
5. One - for the new 230kV line to Lake Murray
6. One - for the new 230kV line to Killian
7. One - for the new 230kV line to Santee Cooper

A total of eleven 230kV breakers are needed at the new generator substation for this design.

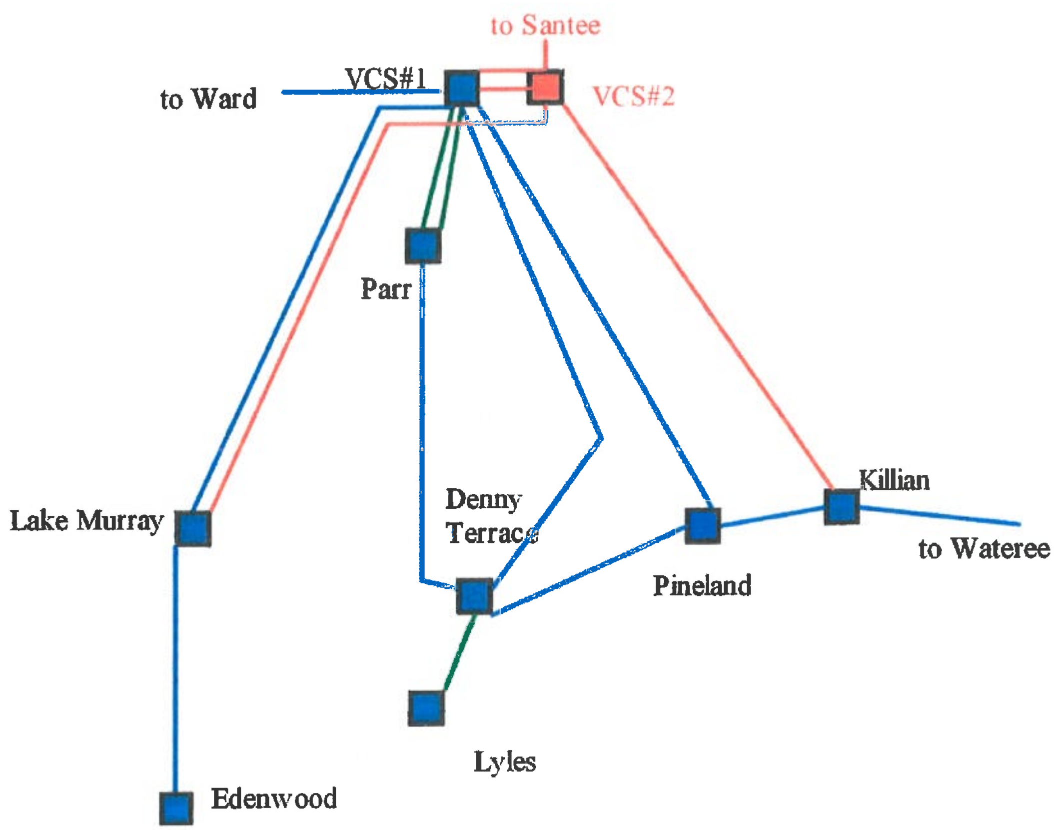
To resolve overstressed conditions of several 230kV and 115kV breakers as described in the Short Circuit Analysis section, Transmission Planning recommends replacing the following breakers with higher interrupting capability breakers:

Location	Voltage	Breaker #
VC Summer	230	8722
VC Summer	230	8732
VC Summer	230	8742
VC Summer	230	8772
VC Summer	230	8792
VC Summer	230	8832
VC Summer	230	8842
VC Summer	230	8852
VC Summer	230	8892
VC Summer	230	8912
VC Summer	230	8942
Parr	230	6402
Parr	230	6412
Parr	230	6422
Parr	230	6432
Parr	230	6442
Saluda Hydro	115	562
McMeekin	115	1051
McMeekin	115	2051
Edenwood	115	2712
Edenwood	115	3672
Edenwood	115	3682
Denny Terrace	115	8032
Denny Terrace	115	8042
Denny Terrace	115	8092

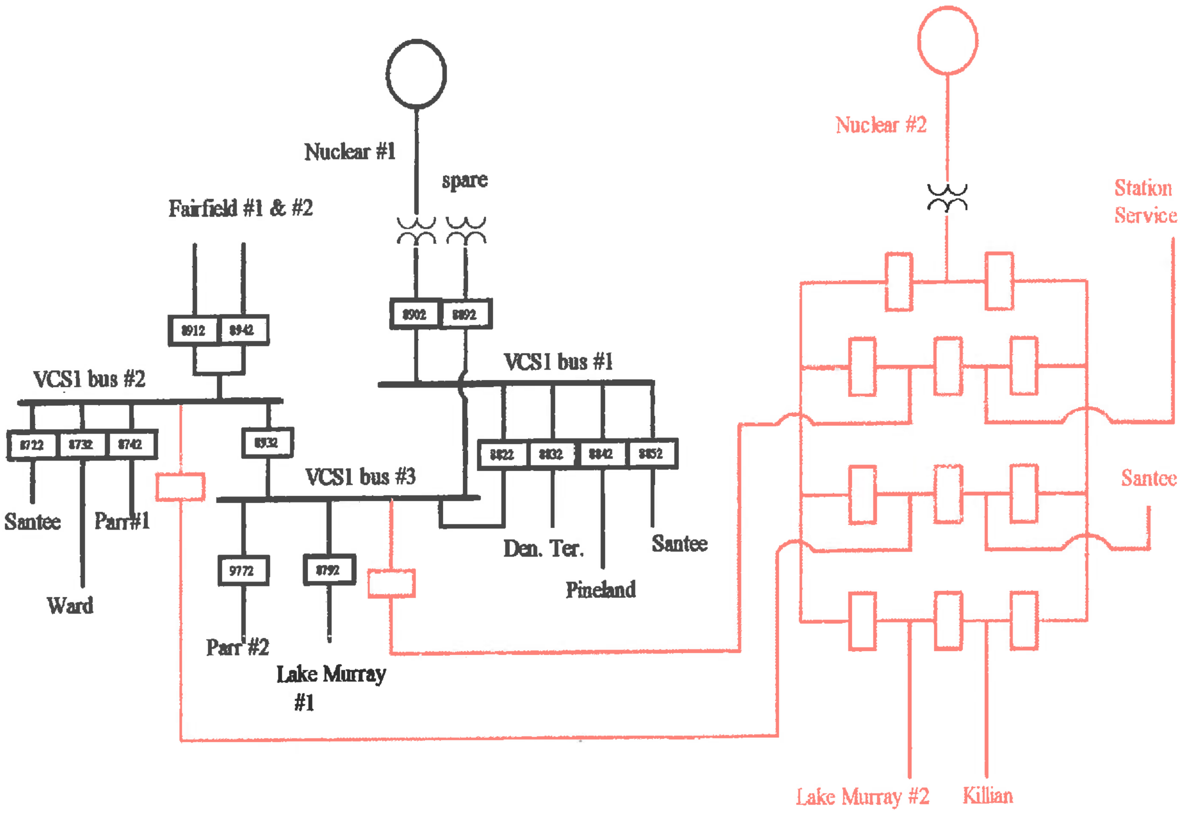
IV. General Engineering Design

Single Line Diagram

Red – New installations
Blue – Existing facilities
Green – Upgraded facilities



Substation Single Line



V. Cost Estimates

All cost estimates are in 2014 dollars.

1. Construct VC Summer-Killian 230kV $25,000,000
   - (add 230kV terminal at Killian) 1,100,000
2. Construct VC Summer-Lake Murray 230kV 17,000,000
   - (add 230kV terminal at Lake Murray) 1,100,000
3. Construct new VC Summer-VC Summer (existing) Bus #2 V 600,000
   - (add 230kV terminal at existing VC Summer Bus #2) 1,100,000
4. Construct new VC Summer-VC Summer (existing) Bus #3 600,000
   - (add 230kV terminal at existing VC Summer Bus #3) 1,100,000
5. Upgrade existing Denny Terrace-Lyles 230kV 1,500,000
6. Upgrade existing Parr-VC Summer #1 230kV 1,400,000
7. Upgrade existing Parr-VC Summer #2 230kV 1,400,000
8. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray 5,000,000
9. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace 8,000,000
10. Upgrade existing Saluda-McMeekin 115kV line 125,000
11. Upgrade existing Lake Murray-McMeekin 115kV line 500,000
12. Upgrade existing Lake Murray-Saluda 115kV 450,000

Construct a new 230kV generator substation at the proposed site
using a breaker-and-a-half design with seven 230kV terminals 12,950,000

Replace overstressed

1. 230kV breakers - 16 3,200,000
2. 115kV breakers - 9 1,350,000

Total Cost Estimate $83,475,000

Generator Interconnection Feasibility Study
For
SCE&G V.C. Summer Nuclear #3
Version #2

Prepared for:
SCE&G Nuclear Group

December 18, 2006

Prepared by:
SCE&G Transmission Planning

TABLE OF CONTENTS

Generator Interconnection Feasibility Study for SCE&G V.C. Summer Nuclear #2

Generator Interconnection Feasibility Studies are intended to be preliminary studies to aid the requestor in determining if the application should advanced to additional, more detailed and more costly studies or be withdrawn. These additional studies include the System Impact Study, Optional Upgrade Studies and the Facility Study. Interconnection Feasibility Studies do not determine the final facilities and costs of interconnecting the requested generator to the existing transmission system.

General Discussion

SCE&G Transmission Planning conducted an initial Generator Interconnection Feasibility Study for V.C. Summer #3 (report dated October 3, 2006) assuming SCE&G would own the entire power output of this unit. Subsequent to releasing the initial report, Transmission Planning was informed that Santee Cooper will own 45 % of the V.C. Summer #3 unit, also. This report presents the results of a study including this information.

The SCE&G Nuclear Group has applied for interconnection of a new 1375 MVA nuclear generator near the existing V.C. Summer site. This new generator would be the third nuclear unit at the V.C. Summer site. This new generator would be jointly owned by SCE&G and Santee Cooper, SCE&G would own 55% and Santee Cooper would own the remaining 45%. In this study SCE&G simulated Santee Cooper's portion of the generator being delivered to the Santee Cooper system.

This study assumes the V.C. Summer #2 unit is complete and all associated transmission as described in the Generator Interconnection Feasibility Study report for V.C. Summer #2 is in-place.

The format of the report is as follows:

I. Generator Information (provided by the SCE&G Nuclear Group)
II. Transmission Studies
   A. Power Flow Analysis
   B. Short Circuit Analysis
III. Preliminary Recommendations
IV. General Engineering Design
V. Cost Estimates

I. Generator Information

The generator design consists of a single nuclear unit and one step-up transformer. The generator unit will have a maximum gross MVA output capacity of 1,375 MVA and a maximum net MW of 1,165 MW.

The generator design consists of the following information:

MVA – gross:	1375
MW – net:	1165
Power Factor:	between .90 and 1.05
Voltage:	22kV
Speed:	1800 rpm
X'd-sat.: 0.465 PU;	X"d-sat.: 0.325 PU
X2-sat.: 0.320 PU;	X0: 0.237 PU

II. Transmission Studies

A. Power Flow Analysis

For the proposed generator interconnection of the VC Summer #3 generator, Transmission Planning performed analyses of:

1. Base case conditions (no outages) simulating normal conditions
2. N-1 conditions simulating single facility outages of each transmission facility on the SCE&G system
3. Selected n-2 conditions simulating the loss of two facilities on the SCE&G transmission system

This study is based on future projected conditions on the SCE&G transmission system, simulating 2016 peak summer conditions and assumes that the following transmission improvements will be made to SCE&G's Columbia and Charleston area transmission system prior to 2016. These transmission improvements are currently scheduled and are needed for other system needs:

1. Upgrade Lyles-William Street 115kV line
2. Upgrade William Street-Coit 115kV line
3. Upgrade Lyles-Denny Terrace 115kV line #1 and #2
4. Add a 2nd Lake Murray 230/115kV auto transformer
5. Increase thermal rating on the Denny Terrace-Lyles 230kV line
6. Upgrade Canadys-Church Creek 230kV line
7. Add a Canadys-Pepperhill 230kV line (double circuit with Canady-Church Creek 230kV Upgrade)

As mentioned earlier, this study assumes the V.C. Summer #2 unit is complete and operating and the following associated transmission projects are complete and in-service:

1. VC Summer-Killian 230kV line
2. VC Summer-Lake Murray 230kV line
3. VC Summer (new)-VC Summer (existing) Bus #2 230kV line
4. VC Summer (new)-VC Summer (existing) Bus #3 230kV line
5. Upgrade the existing Denny Terrace-Lyles 230kV line
6. Upgrade the existing Parr-VC Summer #1 230kV line
7. Upgrade the existing Parr-VC Summer #2 230kV line
8. Add a 3rd 230/115kV 336 MVA auto transformer at Lake Murray
9. Add a 3rd 230/115kV 336 MVA auto transformer at Denny Terrace
10. Upgrade the existing Saluda-McMeekin 115kV line
11. Upgrade the existing Lake Murray-McMeekin 115kV line
12. Upgrade the existing Lake Murray-Saluda 115kV line

Additionally, this study assumes that the following proposed transmission modifications will be made by Santee Cooper to their transmission system as part of their interconnection to the V.C. Summer #2 generator. These transmission improvements were provided by Santee Cooper:

1. Add a VCS-Winnsboro 230kV line with 230/69kV transformers at Winnsboro.
2. Add a Winnsboro-Richburg 230kV line with 230/69kV transformers at Richburg.
3. Add a Richburg-Flat Creek 230kV line

Furthermore, this study assumes that the following proposed transmission modifications will be made by Santee Cooper to their transmission system as part of their interconnection to the V.C. Summer #3 generator. These transmission improvements were provided by Santee Cooper:

1. Add a VCS-Sandy Run 230kV line with a 230/115kV transformer at Sandy Run
2. Add a Sandy Run-Orangeburg 230kV line with a 230/115kV transformer at Orangeburg
3. Add an Orangeburg-St. George 230kV line with a 230/115kV transformer at St. George.
4. Add a St. George-Varnville 230kV line

Run #1 – Injection of the proposed 1,165 MW at the new VC Summer 230kV with no affiliated transmission improvements

For the initial analysis, an additional 1,165 MW is injected at the new VC Summer 230kV bus with no affiliated modifications to the SCE&G transmission system. With the existing VC Summer net generation of 966 MW, the Fairfield Pumped Storage net generation of 608 MW, the proposed VC Summer #2 net generation of 1,165 and the new proposed VC Summer #3 net generation of 1,165, the total net MW generation connected to the 230kV system in the vicinity of the VC Summer site is 3,904 MW.

Base Case Conditions

There are no overloaded facilities in the base case (no outages). However, several existing 230kV lines in the VC Summer area are loaded above 50% of their Normal Rating:

- The VCS#1 bus #1-Pineland 230kV line loads to 58% of its 475 MVA Normal Rating
- The VCS#1 bus #1-Denny Terrace 230kV line loads to 56% of its 475 MVA Normal Rating
- The VCS#1 bus #1-Blythewood (Santee Cooper) 230kV line loads to 77% of its 478 MVA Normal Rating
- The VCS#1 bus #3-Lake Murray 230kV line loads to 52% of its 704 MVA Normal Rating
- The VCS#1 bus #3-VCS New 230kV line loads to 53% of its 950 MVA Normal Rating
- The VCS#1 bus #2-VCS New 230kV line loads to 53% of its 950 MVA Normal Rating
- The Parr-Denny Terrace 230kV line loads to 64% of its 704 MVA Normal Rating
- The Parr-Bush River (Duke) 230kV line loads to 52% of its 456 MVA Normal Rating

- The Lake Murray-Edenwood 230kV line loads to 59% of its 475 MVA Normal Rating

N-1 Conditions
The n-1 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Rating (MVA)	Loading (%)	Contingency
Saluda-White Rock 115kV line	95	111	Parr-Bush River (Duke) 230kV line

Selected N-2 Conditions
The n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Rating (MVA)	Loading (%)	Contingency(s)
Lake Murray 230/115kV auto transformer #1	336	110	Lake Murray 230/115kV auto transformer #2 and Lake Murray 230/115kV auto transformer #3
Lake Murray 230/115kV auto transformer #2	336	110	Lake Murray 230/115kV auto transformer #1 and Lake Murray 230/115kV auto transformer #3
Lake Murray 230/115kV auto transformer #3	336	110	Lake Murray 230/115kV auto transformer #1 and Lake Murray 230/115kV auto transformer #2
VC Summer #1 bus #3-VC Summer New 230kV line	1020	100-135	VC Summer #1 bus #2-VC Summer New 230kV line and various other Columbia Area 230 and 115kV lines
VC Summer #1 bus #2-VC Summer New 230kV line	1020	100-135	VC Summer #1 bus #3-VC Summer New 230kV line and various other Columbia Area 230 and 115kV lines
Saluda-Georgia Pacific 115kV line	95	108	Parr-Bush River (Duke) 230kV line and Saluda-White Rock 115kV line
Saluda-White Rock 115kV line	95	133	Parr-Bush River (Duke) 230kV line and Saluda-Georgia Pacific 115kV line
Saluda-White Rock 115kV line	95	114	Parr-Bush River (Duke) 230kV line and VC Summer-Pomaria (Santee) 230kV line
Saluda-White Rock 115kV line	95	121	Parr-Bush River (Duke) 230kV line and Parr-Newport (Duke) 230kV line
Saluda-White Rock 115kV line	95	117	Parr-Bush River (Duke) 230kV line and VC Summer-Blythewood (Santee) 230kV line
Saluda-White Rock 115kV line	95	115	Parr-Bush River (Duke) 230kV line and VC Summer-Ward 230kV line

Saluda-White Rock 115kV line	95	117	Parr-Bush River (Duke) 230kV line and Wateree-Sumter (Progress) 230kV line
Saluda-White Rock 115kV line	95	116	Parr-Bush River (Duke) 230kV line and VC Summer-Winnsboro (Santee) 230kV line
Saluda-White Rock 115kV line	95	111-114	Parr-Bush River (Duke) 230kV line and one of several other lines in the Columbia Area

The n-2 analyses show the following highly loaded conditions due to the additional generation:

Highly Loaded Facility	Rating (MVA)	Loading (%)	Contingency(s)
Lyles-Edenwood 230kV line	510	80	VC Summer #1 bus #3-Lake Murray 230kV line and VC Summer New-Lake Murray 230kV line
VC Summer #1 bus #1-Denny Terrace 230kV line	510	85	Parr-Denny Terrace 230kV line and VC Summer #1 bus #1-Pineland 230kV line
VC Summer #1 bus #1-Blythewood (Santee Cooper) 230kV line	550	91	Wateree-Sumter (Progress) 230kV line and VC Summer-Winnsboro (Santee Cooper) 230kV line
VC Summer #1 bus #1-Pineland 230kV line	510	89	Parr-Denny Terrace 230kV line and VC Summer new-Killian 230kV line
VC Summer #1 bus #3-Lake Murray 230kV line	755	90	Parr-Denny Terrace 230kV line and VC Summer New-Lake Murray 230kV line
VC Summer New-Lake Murray 230kV line	1020	92	VC Summer #1 bus #3-VC Summer New 230kV line and VC Summer #1 bus #2-VC Summer New 230kV line
Wateree-Sumter (Progress) 230kV line	500	85	Wateree-Orangeburg 230kV line and Wateree-Summerville 230kV line

<u>Run #2 – Create new paths from VC Summer to Charleston Load Center</u>

In Run #1, four of the six major 230kV lines from the VC Summer Area to the Columbia Load Center are highly loaded for an outage of two of the four remaining lines. Upgrades would be needed on at least two of the four lines to address these overloads or additional new 230kV lines from the VC Summer Area to the Columbia Load Center would be needed.

Also in Run #1, the two 230kV lines leaving the VC Summer New 230kV substation to the existing VC Summer Substation, each overload for the outage of the other. To address this, we will evaluate adding a 3rd 230kV line from VC Summer New 230kV substation to the existing VC Summer Substation bus #1 with B1272 conductor.

We also have two major 230kV tie lines that are highly loaded. The 230kV lines are the Wateree-Sumter (Progress) 230kV line (a transmission tie with Progress Energy) and the VC Summer #1-Blythewood (Santee Cooper) 230kV line (a transmission tie with Santee Cooper). The high loading on these two lines shows that the generation is trying to leave the Columbia area or, in other words, the generation in the Columbia area needs another path to a major load center.

In Transmission Planning's 2016 system model, the Columbia area has a projected load of 2,110 MW. In that same year, including the VC Summer #3 1,165 MW generator, there is a total of 5,772 MW of generation located in the Columbia area with 3,793 MW owned by SCE&G and the remainder owned by Santee Cooper (their ownership portion of VC Summer #1, #2 and #3) and the Columbia Energy Center. Just in the VC Summer area, there is a total of 3,904 MW of generation with 2,534 MW belonging to SCE&G.

In Transmission Planning's 2016 system model, the Charleston area has a projected load of 1,960 MW. However, there is only 857 MW of SCE&G generation located in the Charleston area.

All of this information shows that there will be significant generation excess in the Columbia area while there is significant generation deficit in the Charleston area, as indicated in the table below.

Year 2016 Projected Load and Generation Levels

	Total Load (MW)	Total SCE&G Generation (MW)	Difference (MW)
Columbia Area	2,110	4,317	2,207 (excess)
Charleston Area	1,960	857	**-1,103 (deficit)**

The generation deficit in the Charleston area is of concern to Transmission Planning, especially when contingencies are considered. A large portion of the generation in the Charleston area is the AM Williams unit (615 MW). When this unit is outaged the remaining SCE&G generation in the Charleston area is 242 MW creating a generation deficit of **–1,718** MW in the Charleston area. To address this concern, the following analysis will evaluate the effectiveness of new 230kV lines from VC Summer toward the Charleston Load Center.

Power flow simulations show two 230kV circuits will be required to carry an adequate portion of the 1,165 MW being studied away from the VC Summer Generation Site. Adding a total of two new 230kV circuits will carry approximately 300 MW out of the VC Summer area to the Charleston load center during normal conditions.

For Run #2, the following transmission modifications are made:

1. Establish a St George 230kV Switching Station with six line terminals. Fold in the existing Wateree-Summerville 230kV line and the existing Canadys-Santee 230kV line at St George.
2. Add a VC Summer New-St George 230kV line #1 and #2 (double circuit) with B1272 conductor

The additional 230 and115kV overloaded facilities that were identified in Run #1 will be addressed, if needed, in subsequent runs.

Base Case Conditions
There are no overloaded facilities in the base case (no outages).

N-1 Conditions

Overloaded Facility	Rating (MVA)	Loading (%)	Contingency
Saluda-White Rock 115kV line	95	108	Parr-Bush River (Duke) 230kV line

Selected N-2 Conditions
The n-2 analyses show the following overload conditions due to the additional generation:

Overloaded Facility	Rating (MVA)	Loading (%)	Contingency(s)
Saluda-Georgia Pacific 115kV line	95	104	Parr-Bush River (Duke) 230kV line and Saluda-White Rock 115kV line
Saluda-White Rock 115kV line	95	128	Parr-Bush River (Duke) 230kV line and Saluda-Georgia Pacific 115kV line
Saluda-White Rock 115kV line	95	116	Parr-Bush River (Duke) 230kV line and Parr-Newport (Duke) 230kV line
Saluda-White Rock 115kV line	95	112	Parr-Bush River 230kV line and VC Summer #1 bus #1-Blythewood 230kV line
Saluda-White Rock 115kV line	95	113	Parr-Bush River 230kV line and VC Summer #1 bus #2-Ward 230kV line
Saluda-White Rock 115kV line	95	108-113	Parr-Bush River 230kV line and one of various other 230 and 115kV lines in the Cola area
Lake Murray 230/115kV auto transformer #1	336	106	Lake Murray 230/115kV auto transformer #2 and Lake Murray 230/115kV auto transformer #3
Lake Murray 230/115kV auto transformer #2	336	106	Lake Murray 230/115kV auto transformer #1 and Lake Murray 230/115kV auto transformer #3
Lake Murray 230/115kV auto transformer #3	336	106	Lake Murray 230/115kV auto transformer #1 and Lake Murray 230/115kV auto transformer #2

VC Summer #1 bus #3-VC Summer New 230kV line	1020	112	VC Summer #1 bus #2-VC Summer New 230kV line and VC Summer New-Lake Murray 230kV line
VC Summer #1 bus #2-VC Summer New 230kV line	1020	112	VC Summer #1 bus #3-VC Summer New 230kV line and VC Summer New-Lake Murray 230kV line

The n-2 analyses show the following highly loaded conditions due to the additional generation:

Highly Loaded Facility	Rating (MVA)	Loading (%)	Contingency(s)
St George-Canady 230kV line	377	87	AM Williams Generation and St George-Summerville 230kV line
St George-Summerville 230kV line	377	91	AM Williams Generation and Canady-Church Creek 230kV line
St George-Summerville 230kV line	377	92	AM Williams Generation and Canady-Pepperhill 230kV line or Canadys-St. George 230kV line
St George-Summerville 230kV line	377	85	Canadys-Pepperhill 230kV line and Canadys-Church Creek 230kV line
St George-Summerville 230kV line	377	87	AM Williams Generation and Canady-Williams 230kV line
VC Summer #1 bus #1-Blythewood (Santee Cooper) 230kV line	550	83	Wateree-Sumter (Progress) 230kV line and VC Summer-Winnsboro (Santee Cooper) 230kV line
VC Summer #1 bus #1-Pineland 230kV line	510	83	Parr-Denny Terrace 230kV line and VC Summer New-Killian 230kV line
VC Summer #1 bus #3-Lake Murray 230kV line	755	84	Parr-Denny Terrace 230kV line and VC Summer New-Lake Murray 230kV line

Run #3 - Correct Overloaded and Highly Loaded Facilities

In Run #2, the additional generation along with the transmission modifications made to accommodate the generation result in some overloaded and highly loaded lines in the St George and Charleston areas. Also, some Columbia facilities are still showing as overloaded. These will be addressed in this run.

For Run #3, the following transmission modifications are made:

1. Construct a VC Summer New-VC Summer #1 bus #1 230kV line with B1272 conductor
2. Upgrade the St. George-Summerville 230kV line to B1272

3. Upgrade the St. George-Canadys 230kV line to B1272
4. Upgrade the Saluda-White Rock 115kV line to 1272
5. Upgrade the Saluda-Georgia Pacific 115kV line to 1272

Base Case Conditions
There are no overloaded facilities in the base case (no outages).

N-1 Conditions
There are no overloaded facilities due to the additional generation.

Selected N-2 Conditions
The n-2 analyses show the Lake Murray 230/115kV autotransformers continue to overload for the loss of the other two autotransformers. This will be addressed by adding additional 230/115kV transformation in the Lexington area.

Because the VC Summer #3 generator, along with the VC Summer #1 and #2 units, will result in significant nuclear generation on the SCE&G system with electrical power outputs that is not expected to vary with changing load conditions, Transmission Planning is concerned about off-peak system conditions. During light load system conditions in 2016, the total amount of nuclear output on the SCE&G system can exceed the total amount of system load. As part of this study effort, light load, spring peak load and shoulder load (75% of peak) system conditions were reviewed. This review showed that several system facilities overload during contingency conditions at off-peak load conditions due to the expected unusual generation dispatch (all or mostly nuclear generation) and the fact that all this generation is located in one area. Transmission Planning will conduct a more thorough study of these conditions as part of the Generator Interconnection System Impact Study.

B. Short Circuit Analysis

An initial review of the effect of the increased fault current in the SCE&G area indicates that three 230kV breakers and eight 115kV breakers on the SCE&G transmission system may become overstressed with the addition of the VC Summer #3 generator and associated transmission improvements. These overstressed breakers would need to be replaced with higher capacity breakers.

The total short circuit contribution from the SCE&G Transmission System that will be seen at the VC Summer new Substation 230 kV bus is:

Z positive (p.u.)	X/R	Z negative (p.u.)	X/R	Z zero (p.u.)	X/R
0.00033+j0.00501	15.0	0.00034+j0.00501	14.9	0.00031+j0.00348	11.2

These values do not include the contribution of the VC Summer #3 generator. They do include the expanded SCE&G Transmission System with projected improvements at the time of interconnection and generation that is connected to the SCE&G Transmission System (including the proposed VC Summer #2 generator, the existing VC Summer #1 generator and the Fairfield Pumped Storage Units). The values are calculated on a 100 MVA base. A significant change is not expected in this equivalence for the next 10 to 15 years, unless additional generation is interconnected in the area.

III. Preliminary Recommendations

Proposed Transmission Improvements

The analyses performed in this study show that constructing two new 230kV lines from the proposed VC Summer #3 generator to the Charleston area load center, plus additional transmission improvements described below, are required to reliably transmit the SCE&G's ownership portion of the 1,165 MW of the proposed VC Summer #3 generator from the VC Summer area to the remainder of the SCE&G system.

The required transmission projects are:

1. Construct VC Summer-St George 230kV Double Circuit B1272 line (135 miles)
   (Add 2 230kV terminals at VC Summer New)
   (breaker-and-a-half design)

2. Construct VCS New-VCS#1, Bus #1
   (add 230kV terminal at existing VC Summer Bus #1)
   (breaker-and-a-half design)

3. Establish a St George 230kV Switching Station (breaker-and-a-half design)
   (6 terminals - 9 breakers)
   (Add land)

4. Fold-in the Canadys-Santee 230kV line at St George

5. Upgrade the Canadys-St George 230kV line to B1272
   (Upgrade Canadys terminal)

6. Fold-in the Wateree-Summerville 230kV line at St George

7. Upgrade the St George to Summerville 230kV line to B1272
   (Upgrade Summerville terminal)

8. Upgrade Saluda-Georgia Pacific 115kV Double Circuit line to 1272
   (Upgrade Saluda terminal)

Add five (5) terminals (9 breakers) to the VC Summer New substation (breaker-and-a-half design).

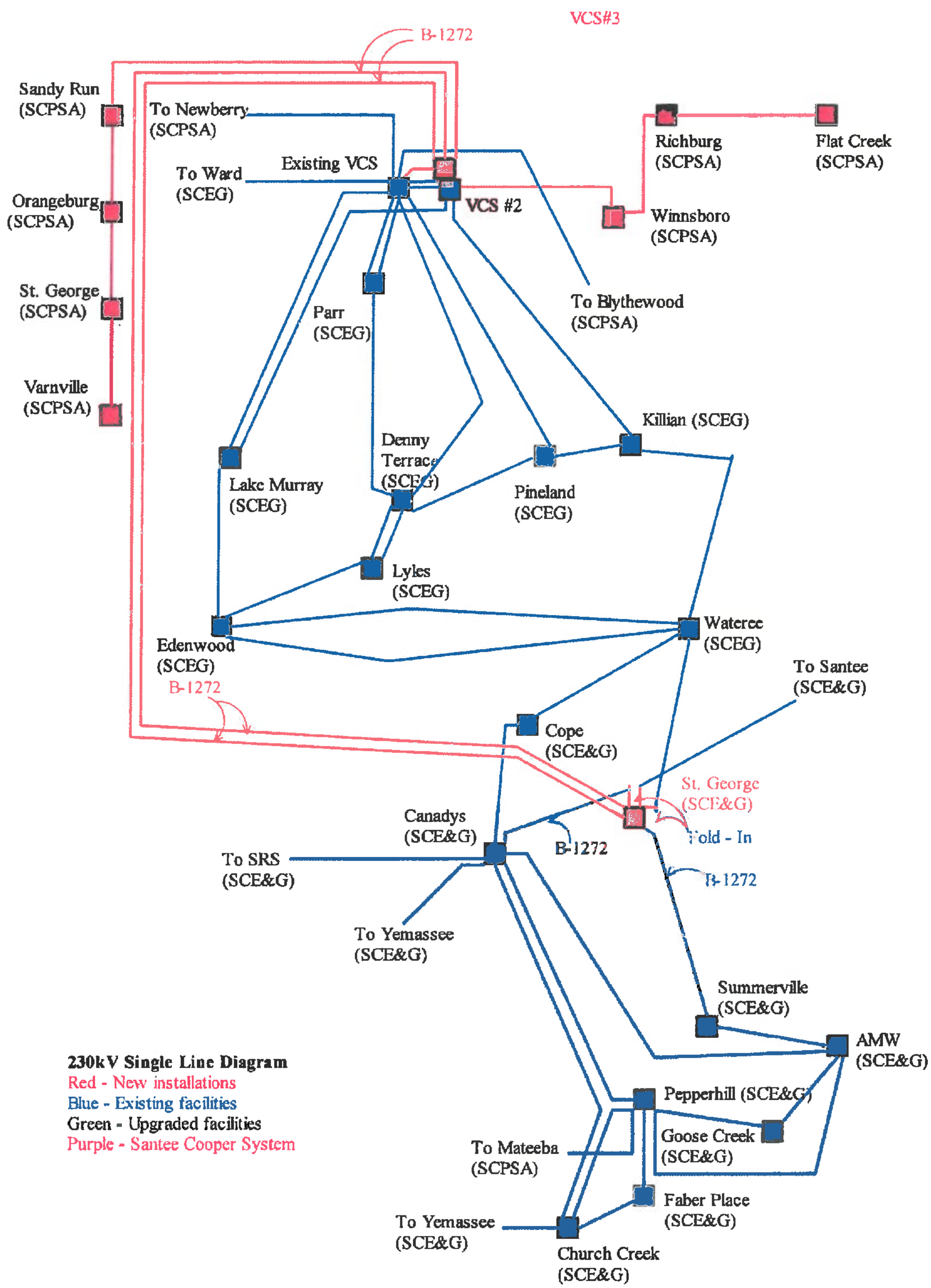
1. One - for VC Summer #3 generator step up transformer
2. One - for VC Summer #3 station service
3. One - for the new 230kV line to the existing VC Summer #1 230kV bus #1
4. Two - for the 2 new 230kV lines to St George

To resolve overstressed conditions of the breakers as described in the Short Circuit Analysis section, Transmission Planning recommends replacing the following breakers with higher interrupting capability breakers:

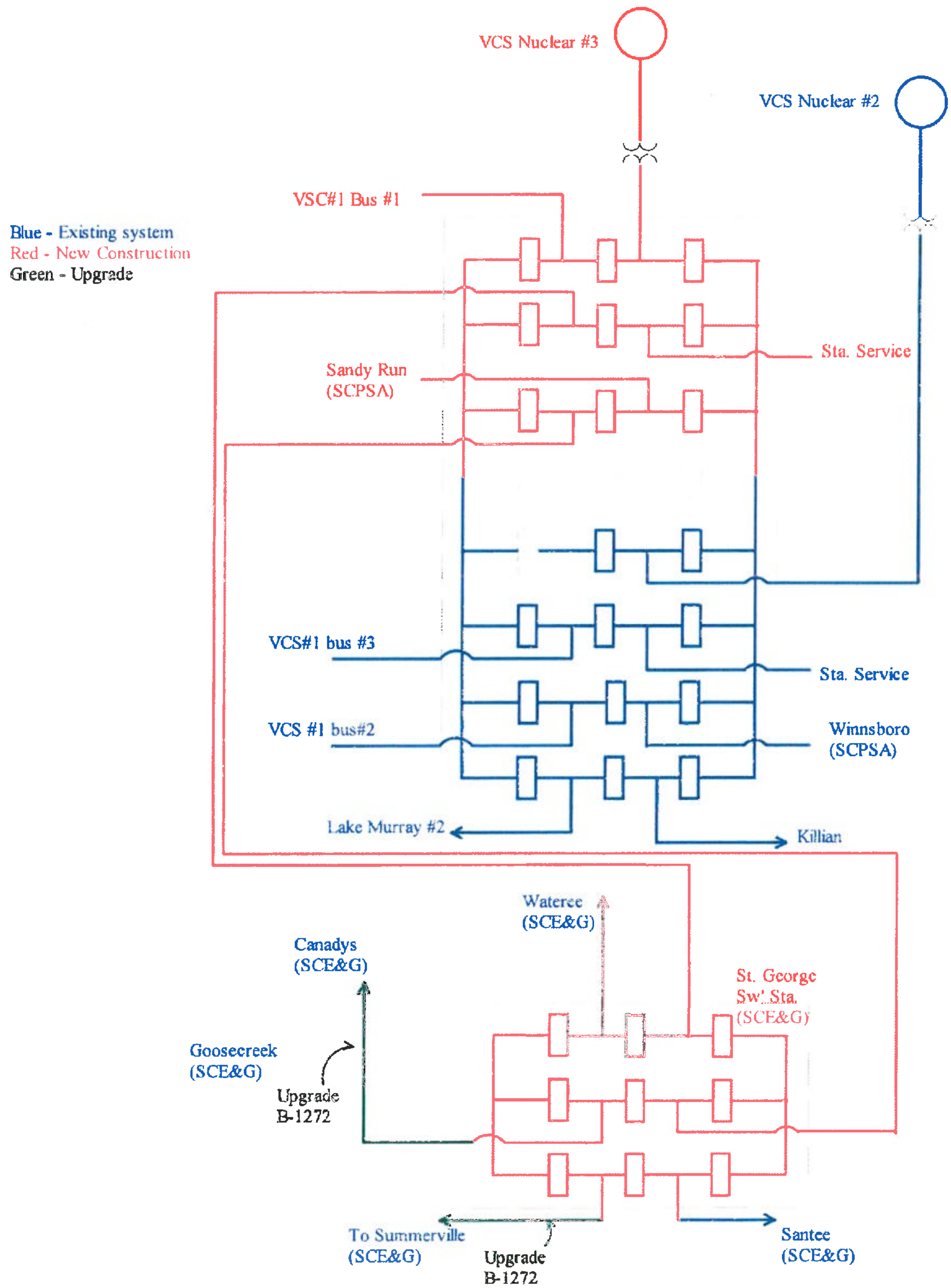
Location	Voltage	Breaker #
VC Summer	230	8822
VC Summer	230	8932
VC Summer	230	8902
Lyles	115	732
Edenwood	115	3052
Dunbar	115	1112
A.M. Williams	115	5712
St. George	115	5002
St. George	115	5022
St. George	115	5052
St. George	115	5082

IV. General Engineering Design

Single Line Diagram



Substation Single Line



V. <u>Cost Estimates</u>

All cost estimates are in 2006 dollars.

1. Construct VC Summer New-St George 230kV
   Double Circuit B1272 line (135 miles) $153,950,000

2. ...Construct VCS New-VCS#1, Bus #1) $600,000
   (add 230kV terminal at existing VC Summer #1 Bus #1) $1,100,000

3. Construct St George 230kV Switching Station
   (Breaker-and-a-half design) $11,400,000

4. Fold-in the Canadys-Santee 230kV line at St George $1,100,000

5. Upgrade the Canadys-St George 230kV line to B1272 .... $7,300,000

6. Fold-in the Wateree-Summerville 230kV line at St George $1,100,000

7. Upgrade the St George to Summerville 230kV line to B1272 .... $15,300,000

8. Upgrade Saluda-Georgia Pacific 115kV Double Circuit line to 1272 $11,900,000

Expand the 230kV generator substation at the VCS New site $12,000,000

Replace overstressed
1. 230kV breakers - 3 .... $600,000
2. 115kV breakers - 8 .... $1,200,000

Total Cost Estimate $217,550,000

 Exhibit No. (HCY-7)
Page 1 of 2

Table I. Transmission System Standards – Normal and Emergency Conditions

Category	Contingencies	System Limits or Impacts		
	Initiating Event(s) and Contingency Element(s)	System Stable and both Thermal and Voltage Limits within Applicable Rating[a]	Loss of Demand or Curtailed Firm Transfers	Cascading Outages
A No Contingencies	All Facilities in Service	Yes	No	No
B Event resulting in the loss of a single element.	Single Line Ground (SLG) or 3-Phase (3Ø) Fault, with Normal Clearing: 1. Generator 2. Transmission Circuit 3. Transformer Loss of an Element without a Fault	 Yes Yes Yes Yes	 No[b] No[b] No[b] No[b]	 No No No No
	Single Pole Block, Normal Clearing[e]: 4. Single Pole (dc) Line	Yes	No[b]	No
C Event(s) resulting in the loss of two or more (multiple) elements.	SLG Fault, with Normal Clearing[e]: 1. Bus Section 2. Breaker (failure or internal Fault)	Yes Yes	Planned/ Controlled[c] Planned/ Controlled[c]	No No
	SLG or 3Ø Fault, with Normal Clearing[e], Manual System Adjustments, followed by another SLG or 3Ø Fault, with Normal Clearing[e]: 3. Category B (B1, B2, B3, or B4) contingency, manual system adjustments, followed by another Category B (B1, B2, B3, or B4) contingency	Yes	Planned/ Controlled[c]	No
	Bipolar Block, with Normal Clearing[e]: 4. Bipolar (dc) Line Fault (non 3Ø), with Normal Clearing[e]: 5. Any two circuits of a multiple circuit towerline[f]	Yes Yes	Planned/ Controlled[c] Planned/ Controlled[c]	No No
	SLG Fault, with Delayed Clearing[e] (stuck breaker or protection system failure): 6. Generator 7. Transformer 8. Transmission Circuit 9. Bus Section	Yes Yes Yes Yes	Planned/ Controlled[c] Planned/ Controlled[c] Planned/ Controlled[c] Planned/ Controlled[c]	No No No No

D [d] Extreme event resulting in two or more (multiple) elements removed or Cascading out of service.	3Ø Fault, with Delayed Clearing [e] (stuck breaker or protection system failure): 1. Generator 2. Transmission Circuit 3. Transformer 4. Bus Section 3Ø Fault, with Normal Clearing[e]: 5. Breaker (failure or internal Fault) 6. Loss of towerline with three or more circuits 7. All transmission lines on a common right-of way 8. Loss of a substation (one voltage level plus transformers) 9. Loss of a switching station (one voltage level plus transformers) 10. Loss of all generating units at a station 11. Loss of a large Load or major Load center 12. Failure of a fully redundant Special Protection System (or remedial action scheme) to operate when required 13. Operation, partial operation, or misoperation of a fully redundant Special Protection System (or Remedial Action Scheme) in response to an event or abnormal system condition for which it was not intended to operate 14. Impact of severe power swings or oscillations from Disturbances in another Regional Reliability Organization.	Evaluate for risks and consequences. ▪ May involve substantial loss of customer Demand and generation in a widespread area or areas. ▪ Portions or all of the interconnected systems may or may not achieve a new, stable operating point. ▪ Evaluation of these events may require joint studies with neighboring systems.

a) Applicable rating refers to the applicable Normal and Emergency facility thermal Rating or system voltage limit as determined and consistently applied by the system or facility owner. Applicable Ratings may include Emergency Ratings applicable for short durations as required to permit operating steps necessary to maintain system control. All Ratings must be established consistent with applicable NERC Reliability Standards addressing Facility Ratings.

b) Planned or controlled interruption of electric supply to radial customers or some local Network customers, connected to or supplied by the Faulted element or by the affected area, may occur in certain areas without impacting the overall reliability of the interconnected transmission systems. To prepare for the next contingency, system adjustments are permitted, including curtailments of contracted Firm (non-recallable reserved) electric power Transfers.

c) Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted Firm (non-recallable reserved) electric power Transfers may be necessary to maintain the overall reliability of the interconnected transmission systems.

d) A number of extreme contingencies that are listed under Category D and judged to be critical by the transmission planning entity(ies) will be selected for evaluation. It is not expected that all possible facility outages under each listed contingency of Category D will be evaluated.

e) Normal clearing is when the protection system operates as designed and the Fault is cleared in the time normally expected with proper functioning of the installed protection systems. Delayed clearing of a Fault is due to failure of any protection system component such as a relay, circuit breaker, or current transformer, and not because of an intentional design delay.

f) System assessments may exclude these events where multiple circuit towers are used over short distances (e.g., station entrance, river crossings) in accordance with Regional exemption criteria.

SOUTH CAROLINA ELECTRIC & GAS COMPANY

LONG RANGE PLANNING CRITERIA

It is recognized that the reliability of power supply in local areas is the responsibility of the individual systems and that each system has internal criteria relating to the more common contingencies. It is further recognized that there are severe contingencies, which are credible, but of a low probability of occurrence, which may result in conditions such as islanding and/or loss of load. Such conditions are considered acceptable as long as they are controlled so as to limit the adverse impact of the disturbance and so as to leave the system or systems in such condition as to permit rapid load restoration and/or reconnection.

The requirements of the SCE&G "LONG RANGE PLANNING CRITERIA" will be satisfied if the system is designed so that during any of the following contingencies, only short-time overloads, low voltages and local loss of load will occur and that after appropriate switching and re-dispatching, all non-radial load can be served with reasonable voltages and that lines and transformers are operating within acceptable limits.

a. Loss of any bus and associated facilities operating at a voltage level of 115kV or above.

b. Loss of any line operating at a voltage level of 115kV or above.

c. Loss of entire generating capability in any one plant.

d. Loss of all circuits on a common structure.

e. Loss of any transmission transformer.

f. Loss of any generating unit simultaneous with the loss of a single transmission line.

Outages more severe are considered acceptable if they will not cause equipment damage or result in uncontrolled cascading outside the local area.